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French Burr Vertical Grinding Mills.

The engravings on this page and page 2 are of an improved vertical burr grinding mill, built by the Case Wheel & Mill Co., Bristol, Conn.

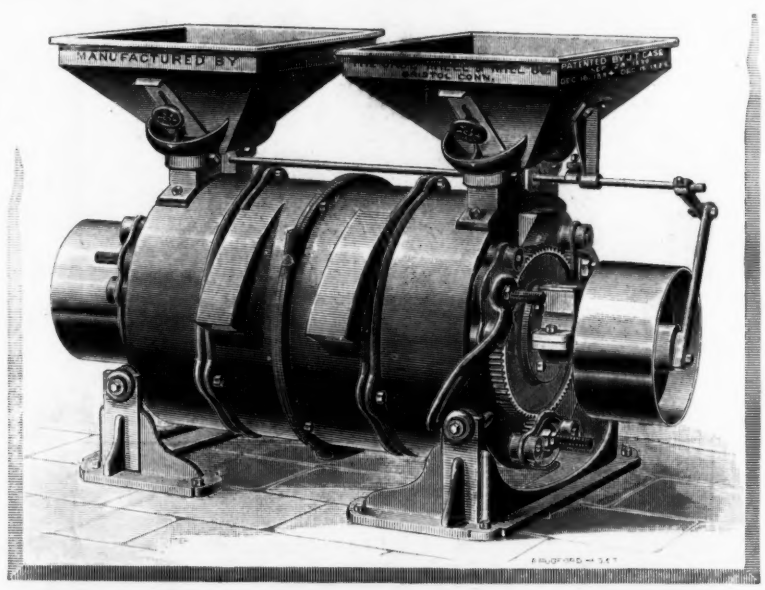
Those on this page are of a double mill, having a shaft which runs entirely through with a driving pulley upon each end. In the center of the shaft is fixed the running stone, on each side of which are bed stones which are cemented into bed plates. From the bed plates there extend three screws, which pass through the outer case, and have fitted to them small pinions and set nuts. The three pinions are made to move together by means of the large spur gear shown. By these screws the stones are adjusted for the various kinds of grinding, and the fact of their being made to move together ensures a uniform adjustment. The hoppers are so made that a partition may be placed through the middle of them, and two kinds of grain fed in at the same time in each hopper, with provision for independent adjustment of feed to regulate the proportion of the two kinds of grain. The grain falls from the shaker onto the screw which is on the shaft, and is fed to the stones, the discharge being at the side of the case. End motion of the shaft is prevented by a double collar step bearing. The bed plates, to which the bed stones are cemented, can, by means of lock nuts on the adjusting screws, be prevented from coming together in case the grain runs out, and yet, if any foreign substance, such as a nail or bolt, should go in, the stones will separate and allow it to pass through without serious injury being done. This is from the fact that the bed plates rest upon six rubber cushions, which exert sufficient pressure for grinding, and yet yield and allow the stones to separate, when necessary, to prevent their injury.

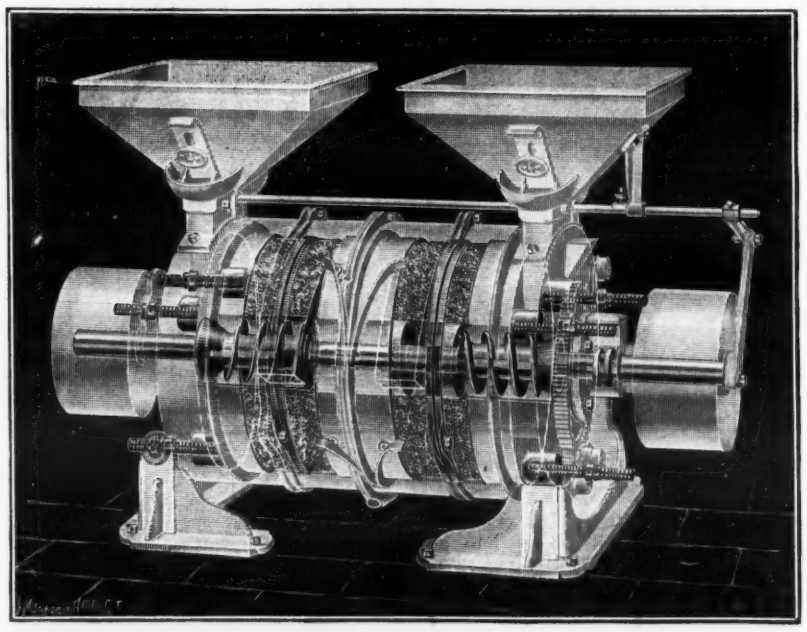
A mill constructed in this way, with a runner in the middle, and a bed stone on each side, has the advantage that all end thrust is taken off the shaft, the thrust on one grinding surface balancing that on the other.

The outer case is of iron, in two parts bolted together, and things are so arranged that the case may easily be separated, and the stones swung into position for dressing.

Around the outside of the running stones are placed fans for circulating air through the grain and clearing the mill. At the right of the cut the wrench is seen in position for adjusting the stone on that side.

The cuts on page 2 are of a single mill, constructed upon the same principle.





VERTICAL GRINDING MILLS.

The Modern Steam Plant and its Management.

BY PETER H. BULLOCK.

INTRODUCTORY.

In what may be presented under the above title, the writer does not lay claim to any superior mechanical knowledge, as the right to say, "This way is surely right," or "That way is positively wrong," for conditions differ in various parts of the country, and what may be good and safe practice in one section may be dangerous in another. It will simply be my aim to discuss the various methods and practices as they have presented themselves during an experience of twenty-five years, in which time it has been my fortune to be a fireman and apprentice, a journeyman machinist and an engineer, under various conditions, from a simple runner of an engine to being in charge of a plant. And let me state right here my belief that the qualities necessary for success in the latter position can be cultivated under any of the "previous conditions of servitude" referred to.

The tendency at the present time is toward consolidation, and the combination of industries that make necessary a large investment in apparatus for generating steam, for converting the steam into power or other methods of work, and for the transmission of the power to where it is required for all the uses our civilization has made necessary and desirable. The duties and responsibilities of those in charge of such apparatus varies according to how far their authority extends, which in some cases is to make the steam and convert it into power, while in other cases they may have charge of the various means employed for its transmission. But be the authority of him in charge limited or extended, it should be his constant aim to see that all the methods and apparatus employed for these purposes are kept so adjusted that the greatest amount of heat, *i. e.*, power, that it is possible to obtain from the fuel consumed is delivered at the point where his authority or responsibility may end.

The fuel may be burned economically, and the greatest possible amount of steam generated from it, while defects in the apparatus for its conversion into power may be sufficient to make the indicated horse-power per pound of fuel fall far below the best records in that direction. Or, again, the generation and conversion into power may be as near perfection as our present knowledge of the subject will permit, but the means of transmission and use may be so faulty, that the difference between the power developed by the engine, and that converted into useful work at the machines, may be enough to materially affect the profits at the financial end of the establishment.

It will therefore be seen that, to secure the best results, there must be good apparatus and intelligent management all along the line, from the coal heap to the material-producing machines, and that these results are more likely to be obtained under one than under separate heads, competency for the various duties being of course imperative. It then follows that the measurement of commercial success very largely depends upon the amount of goods produced per pound of fuel, and that this wholly depends upon the efficiency and management of the steam and power plant as a whole.

It will not do, however, to ignore the indicator so as to become indifferent to the horse-power and its relation to the fuel; on the contrary, it should be constantly consulted, and its instructive lines carefully studied. It should not be a harbor for an engineer to anchor in, but a lighthouse to guide his course. We of the present day have much light to be thankful for that our predecessors did not enjoy. We have the benefit of their experience, and the warnings of their failures. We have appliances for the safety of our apparatus, and for the convenient and accurate operation of the same, that were unknown to them. The nature of the forces with which we deal, and the strength of the material necessary for their confinement, are better known; in fact, as the engineer of to-day advances through the open door of progress he finds the court of knowledge broadening out before him, ready for his exploration. It is too often we see men trying to contract their responsibilities to correspond with their present knowledge, instead of striving to broaden the scope of their abilities by observation and study, thereby fitting themselves to occupy better positions and enjoy the accompanying honors and emoluments.

From the foregoing may be inferred the writer's opinion of how a steam plant should be constructed, and the kind of a man that should be in charge of it.

The boiler room will be the subject of the next paper.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

TWENTY-FIRST PAPER.

If an engineer is desirous of building a so-called cheap marine engine, he will probably adopt some web and flange design for the uprights, as the expense in pattern making and casting is somewhat greater in the split double girder upright than it is in the web and flange type. The latter system requires a core-box, and it must be cast in dry sand, thus increasing the first cost, but not enough to justify the use of flanged or green sand casting.

The upper portion of the stems of the upright girders will be rectangular in cross section, with an outside length fore and aft of 23″, and with a transverse width of 16″ at the underside of the upper flange, and this width will continue downward for a distance of 20″, at which point it will merge into the curved portion of the girder, where it begins to swell outward for connecting-rod clearance (the connecting-rod will be 11′ 3″ long from center to center of pins).

The crosshead will have a distance of $14\frac{11}{16}$″ from the center of the pin bearing to the top of the jaw portion of the combination forging.

There will be a net clearance of 8″ when the crosshead is on the full up stroke, between it and the sleeve gland, when it is

slacked full down, and this sleeve gland will then be 12½″ below the cylinder joint, and, as the flange bracket on the cylinder will be faced even with the joint, we have a total distance (adding half the stroke, 2′ 3″), of 16′ 4 1 3/16″ from the center of the shaft to the top of the uprights, where they join the cylinder.

The seatings on the bed-plate, to receive the upright frames, will be planed off on the same level as the cap seats for the main shaft boxes, and as these boxes are 20″ in diameter outside, the center of the shaft will be 12″ below the girder seatings, allowing a fit of 2″ on the cap. The distance of 12″ must be subtracted from 16′ 4 1 3/16″, leaving a total height for the upright girders of 15′ 4 3/16″. It will be 19 1 3/16″ from the top of the girder down to the wearing shoulders on the faces and edges of the guides, but the ends of the guides will be 9″ above this point, and will have oil-pans cast in them, just above the shoulders. The bolts for holding the guides to the girders will be outside of the oil-pans.

The guides will be 80″ long on the portions traveled by the gibs, while these gibs will be 27″ long, and will pass over the shoulders on the guides, ½″ at each end. At the lower end of the guides there will be oil-pans bolted to the faces and edges of the guides, 5″ in depth, and 2¼″ in width. The extreme length of the guides will be 8′ 2″, and the seats on the girders, for receiving the guides, will be raised, to allow the projecting water-back to pass between them. The extreme top ends of the guides will be 10″ below the top of the girder frames, consequently the extreme lower ends of the guides will be 9′ below the top of the frames, and 6′ 4 3/16″ above the frame seats on the bed-plates.

The usual practice is to begin to split, or part the girder, at the lower ends of the guides, in order to form the two legs and feet, but this design frequently causes a sharp angle of the legs; sometimes so sharp, that their strength to resist the rapid vertical strains is very much impaired. To avoid any approach to a weak design, I shall begin the parting of the legs of the girders 5′ 3″ from their upper ends, and to form a continuation of the seats for receiving the guides, extend flanges inward from each leg. The faces of the guides will be 38″ apart; the thickness of the front faces will be 1¾″, the water spaces 2½″, and the thickness of the back ¾″. There will be ½″ clearance between the water-back and the inside faces of the girder frames, so that these faces will be 47½″ apart on all of the cylinders.

The top flanges of the girder frames will be cast of sufficient thickness to receive the wooden seatings for the cylinder brackets to rest on, and they will project on the extreme outside 4½″ from the body of the main frames, in order to receive the holding down bolts of the cylinders.

Before proceeding with a detailed description of the upright girder frames, we must fix the distances between the centers of the cylinders. The distance between the high and intermediate-pressure cylinders will be the same as that between the intermediate and low-pressure cylinders, for the reason that the three sections of the crank-shaft will be exactly alike in all dimensions. We must fix our centers between the cylinders by adding the length of the two bearings, the thickness of the two crank plates, the thickness of the flanges and bolts of one pair of coupling flanges, the length of one crank-pin box (counting one-half for each side), and the length of the hub of one eccentric; and when these distances are added together they will give us a distance of 84″ between cylinder centers.

The above distance will allow a clearance of 17½″ between the intermediate and low-pressure cylinder laggings, and 37″ between the intermediate and high-pressure cylinder laggings. The upright girder frames can then be spread 7′ from outside to outside of flanges on the lower legs, or 6′ 3″ from outside to outside of the bodies of the legs, thus resenting a very rigid structure, and one that will resist all the strains, under the most trying conditions.

The lower legs will have projecting flanges 4½″ wide all the way around them. These lower flanges will be 3½″ thick, and will be drilled for eight 2⅝″ steel bolts for each leg. Well-rounded corners will join these flanges to the bodies of the legs, and when drilling flanges for the bolts a facing cutter will be used to form a perfect seating for each nut.

Fink Still in Trade.

The following letter from the Sanford Fork and Tool Co., of Terre Haute, Ind., explains itself. It may be added that the chief exposure of Fink's methods appeared in the AMERICAN MACHINIST for 1884:

It is perhaps right that we should inform you that the notorious Fink, of oil mixture fame, is again on his travels through the country. He is accompanied, as heretofore, by a vast array of testimonials from the best manufacturing firms in the country, testifying to the merits of the oil mixture, the right to use which he is selling. It had escaped our minds that this man had been fully exposed in your valued paper, and, after a good deal of talking and showing of testimonials, we finally decided to buy the right to use it, in payment thereof giving our check for $150.00. He had no sooner left the office with the check in his possession, than it began to dawn upon us that he was a fraud, and the matter had been fully exposed in your paper. On referring to it, we found that we had not all the copies which contain the correspondence and your exposures referring to it. We have the issues of '85, '86, '87, '88, and we write now for the purpose of asking you if you can furnish us with the issues previous to these dates, which have any reference to this matter.

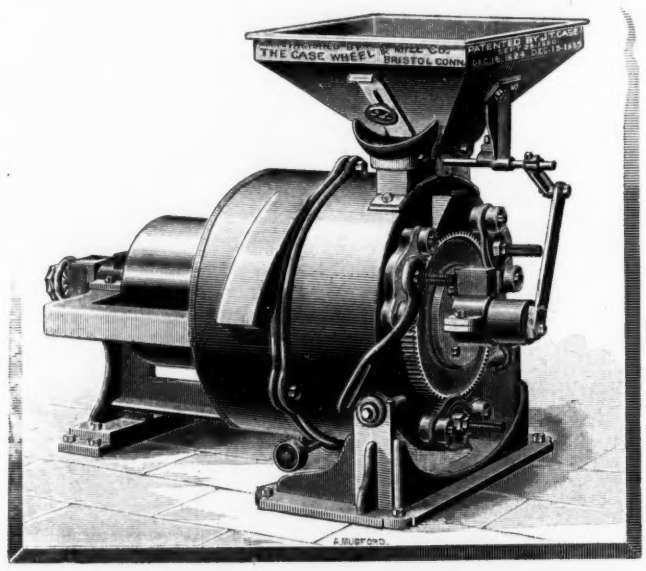
However, to resume our experience with the renowned Fink, he presented our check at the bank, and, of course it was not paid, as we had stopped payment by telephone; and within the last day or two we have received notice that he has given it to a firm of lawyers here for collection. We, of course, are going to fight it, and in the interest of the public at large, we would ask you to give us all the information you can.

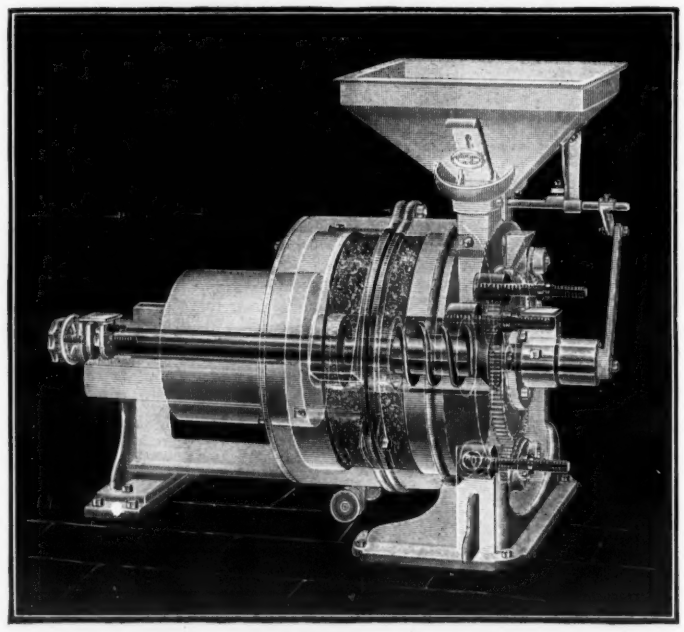
The effort in England, to tow canal boats with locomotives, has not, so far, been successful.

Regulator for Natural Gas.

Dr. C. E. Waldurff, of Buffalo, N. Y., has invented a regulator for natural gas, which is thus described by the *Buffalo Courier:*

The regulator, which weighs but a pound and a half, and has no valves whatever, was found attached to a supply and distributing pipe. It is intended to be placed on the supply pipe outside the meter. It consists of a branch of the main pipe, upon which is a rubber bulb filled with air, into which no gas can enter, as the bulb is air-tight. The gas acts against the air like a cushion, expanding or contracting it as the pressure is increased or diminished. Against this bulb, and on the opposite sides of it, are a pair of pressure arms, to each of which is attached an iron governor. The tripping lever is acted upon by the pressure of the gas as exerted on the pressure arms, and relieves a weight as the pressure increases above a certain amount. The weight is attached by a hook to the tripping lever, and also to a chain, the other end of which is wound about an ordinary globe valve in the pipe. When the weight is thrown off the tripping lever, it falls and unwinds from the valves, closing the valve as it does so. This regulator is gauged at half an ounce and seven ounces, and can be gauged to trip at any desired pressure. The machine is also a perfect test for any leakage in any of the distributing pipes, making it a valuable safeguard against leakage from any cause.





VERTICAL GRINDING MILLS.—SEE PAGE 1.

Modern Locomotive Construction.

BY J. G. A. MEYER.

EIGHTIETH PAPER.

Main rods are often made of iron, sometimes of steel; when of the former, the best quality of hammered iron must be used. The rules for finding the dimensions of main rods (given in our last paper) are suitable for rods made of the best hammered iron. When made of steel, the rods may be made slightly lighter. But since, in many cases, steel rods are adopted simply for the purpose of ensuring greater safety, and not so much for the purpose of reducing the weight, no difference in the dimensions between iron and steel rods is made.

For the sake of convenience in designing, we have given the following tables containing the dimensions for iron main rods. These have been determined by the rules given in the previous paper. In the dimensions given we have avoided those containing less than one 1/16 of an inch, and selected such as agreed nearest with the decimals found.

TABLE A.

THICKNESS OF MAIN RODS, DEPTH OF THE SAME AT THE SMALL AND LARGE ENDS. RODS MADE OF BEST HAMMERED IRON. MAXIMUM STEAM PRESSURE PER SQUARE INCH OF PISTON, 120 POUNDS.

Diam. of Cylind'rs.	Thick-ness.	Depth at Small End.	Depth at Large End.
9″	15/16″	1 5/8″	2″
10″	1″	1 11/16″	2 1/4″
11″	1 1/8″	2″	2 1/2″
12″	1 1/4″	2 1/8″	2 3/4″
13″	1 3/8″	2 3/16″	2 15/16″
14″	1 7/16″	2 5/8″	3 1/8″
15″	1 9/16″	2 11/16″	3 3/16″
16″	1 5/8″	2 3/4″	3 5/8″
17″	1 3/4″	2 7/8″	3 7/8″
18″	1 7/8″	3 1/16″	4 1/16″
19″	2″	3 1/4″	4 1/4″
20″	2 1/16″	3 7/16″	4 1/2″
21″	2 1/8″	3 5/8″	4 3/4″
22″	2 3/16″	4″	5″

TABLE B.

THICKNESS OF MAIN RODS, DEPTH OF THE SAME AT THE SMALL AND LARGE ENDS. RODS MADE OF BEST HAMMERED IRON. MAXIMUM STEAM PRESSURE PER SQUARE INCH OF PISTON, 130 POUNDS.

Diam. of Cylind'rs.	Thick-ness.	Depth at Small End.	Depth at Large End.
9″	1″	1 11/16″	2 1/8″
10″	1 1/16″	1 7/8″	2 3/8″
11″	1 1/8″	2 1/16″	2 5/8″
12″	1 3/16″	2 1/4″	2 13/16″
13″	1 5/16″	2 7/16″	3 1/16″
14″	1 7/16″	2 5/8″	3 5/16″
15″	1 1/2″	2 13/16″	3 1/2″
16″	1 5/8″	3″	3 3/4″
17″	1 13/16″	3 3/16″	4″
18″	1 15/16″	3 3/8″	4 1/4″
19″	2 1/16″	3 9/16″	4 1/2″
20″	2 1/8″	3 3/4″	4 11/16″
21″	2 1/4″	3 15/16″	4 15/16″
22″	2 3/8″	4 1/8″	5 3/16″

TABLE C.

THICKNESS OF MAIN RODS, DEPTH OF THE SAME AT THE SMALL AND LARGE ENDS. RODS MADE OF BEST HAMMERED IRON. MAXIMUM STEAM PRESSURE PER SQUARE INCH OF PISTON, 140 POUNDS.

Diam. of Cylind'rs.	Thick-ness.	Depth at Small End.	Depth at Large End.
9″	1″	1 3/4″	2 3/16″
10″	1 1/8″	1 15/16″	2 7/16″
11″	1 1/4″	2 1/8″	2 11/16″
12″	1 5/16″	2 3/8″	2 15/16″
13″	1 7/16″	2 9/16″	3 3/16″
14″	1 9/16″	2 3/4″	3 7/16″
15″	1 11/16″	2 15/16″	3 11/16″
16″	1 13/16″	3 1/8″	3 15/16″
17″	1 15/16″	3 5/16″	4 1/8″
18″	2″	3 1/2″	4 3/8″
19″	2 1/16″	3 11/16″	4 5/8″
20″	2 1/4″	3 15/16″	4 7/8″
21″	2 3/8″	4 1/8″	5 1/8″
22″	2 7/16″	4 5/16″	5 3/8″

TABLE D.

THICKNESS OF MAIN RODS, DEPTH OF THE SAME AT THE SMALL AND LARGE ENDS. RODS MADE OF BEST HAMMERED IRON. MAXIMUM STEAM PRESSURE PER SQUARE INCH OF PISTON, 150 POUNDS.

Diam. of Cylind'rs.	Thick-ness.	Depth at Small End.	Depth at Large End.
9″	1 1/16″	1 13/16″	2 1/4″
10″	1 1/8″	2″	2 1/2″
11″	1 1/4″	2 1/4″	2 3/4″
12″	1 3/8″	2 7/16″	3″
13″	1 1/2″	2 5/8″	3 1/4″
14″	1 5/8″	2 13/16″	3 1/2″
15″	1 3/4″	3″	3 3/4″
16″	1 7/8″	3 1/4″	4″
17″	1 15/16″	3 7/16″	4 1/4″
18″	2 1/16″	3 5/8″	4 9/16″
19″	2 3/16″	3 7/8″	4 13/16″
20″	2 5/16″	4 1/16″	5 1/16″
21″	2 7/16″	4 1/4″	5 5/16″
22″	2 9/16″	4 7/16″	5 9/16″

TABLE E.

THICKNESS OF MAIN RODS, DEPTH OF THE SAME AT THE SMALL AND LARGE ENDS. RODS MADE OF BEST HAMMERED IRON. MAXIMUM STEAM PRESSURE PER SQUARE INCH OF PISTON, 160 POUNDS.

Diam. of Cylind'rs.	Thickness.	Depth at Small End.	Depth at Large End.
9″	1 1/16″	1 7/8″	2 5/16″
10″	1 1/16″	2 1/16″	2 5/8″
11″	1 1/16″	2 5/16″	2 7/8″
12″	1 1/16″	2 1/2″	3 1/8″
13″	1 1/16″	2 11/16″	3 3/8″
14″	1 1/16″	2 7/8″	3 5/8″
15″	1 1/16″	3 1/16″	3 15/16″
16″	1 1/16″	3 5/16″	4 1/8″
17″	2 1/16″	3 9/16″	4 7/16″
18″	2 1/16″	3 3/4″	4 3/4″
19″	2 5/16″	3 15/16″	4 15/16″
20″	2 3/8″	4 1/8″	5 1/4″
21″	2 1/2″	4 3/8″	5 1/2″
22″	2 5/8″	4 5/8″	5 3/4″

SIDE RODS.

When we consider all the conditions under which a side rod must transmit motion from one wheel to another, it will be seen that to design such a rod is not as easy as to design a main rod. We have seen that a main rod should be stiff enough to do its work without buckling in any direction; and since we can estimate very closely the pressure to which it will be subjected, its strength to resist these pressures can be readily determined, as shown by the foregoing rules. Side rods, however, labor under disadvantages to which the main rods are not subjected. Wear will create play between the axle-boxes and wedges, allowing the axles to run out of their proper adjustment, and thereby throwing an extra stress on the side rods; uneven tracks will throw the side rods out of parallelism, which will again increase the stress on the rods; unequal wear of tires, which, practically means a difference in the diameter of the wheels, and consequently that one or the other wheel must slip a certain amount during each revolution; but this slip, due to the unequal diameters of the wheels, cannot take place through any other agency than the side rod, and consequently the rod will again be subjected to an extra thrust or pull. But slip is not only due to the unequal wear of tires; it is also caused by the form of the tread of tires, and, as we have seen in previous papers, many tires have a cone tread; consequently, in curving, the wheels having such treads will run on one side of the engine on larger diameters than on the other side, and, consequently, slip must occur. Another feature, which presents itself in connection with curving, is that the play between the axle-boxes and wedges will cause the axles to run out of parallelism, and all this tends to throw extra stress on the side rods. Comparatively sudden stopping, by the application of brakes; running over slippery places on the rails; or incautious use of sand often plays mischief with the side rods.

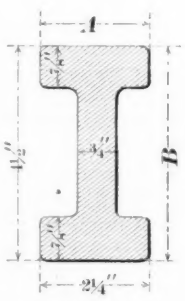


Fig. 464

Now, these conditions are disadvantages under which a side rod labors, and may at times throw on it extraordinary pressures which cannot be accurately determined, but can only be approximately estimated.

Side rods should be made as light as possible, so as to reduce the stresses due to the action of the centrifugal force to a minimum, yet they must be strong enough to resist the tensile and compressive forces to which they are alternately subjected. When side rods are subjected to a compressive force or thrust, they must not buckle in a vertical direction, that is, in the direction of arrow 2, Fig. 458; yet, under certain circumstances, it is desirable that they should, to a limited extent, slightly spring or buckle in a horizontal direction, that is, in the direction of arrow 3. The reason for desiring a slight spring of the side rods in a horizontal direction is to obtain a certain amount of flexibility, so as to avoid excessive jerks on the rod and crank-pin, and thereby lessen the danger of heating the crank-pin brasses, or breaking the crank-pins or side rods. Here we notice a difference between the essential conditions demanded from a main rod and a side rod; the former must do its work without buckling in any direction, the latter should not buckle in a vertical direction, but should have a certain amount of flexibility by springing to a slight extent in a horizontal direction; and these requirements the designer should not lose sight of.

Now, a side rod which shall meet all the demands made upon it, must have a proper distribution of metal, and must also be of such a form as will reduce the cost of manufacture to a minimum. Consequently, various types of side rods are now in use.

In the early stages of locomotive building, many side rods with circular transverse sections were used, the diameter of the central section being larger than the diameters of the end sections. This type of rod was finally abandoned, because, although cheap to manufacture, it had the same rigidity both vertically and horizontally, which, as we have seen, is objectionable.

Probably the most popular type of side rod at present in use is that shown in Figs. 458, 459. This rod has a uniform, rectangular transverse section throughout. It has a certain amount of flexibility in the direction of arrow 3, and is, comparatively, not a costly rod to make. This rod is extensively used both for freight and passenger engines. On account of its cheapness, it is nearly always adopted for freight engines; but for fast passenger service its metal is not considered to be correctly distributed, and, consequently, we now frequently meet with passenger engines for which a type of side rod such as is shown in Figs. 460, 461 has been adopted. The transverse section of this rod is of the I form, as shown in Fig. 464, here drawn to a larger scale than Figs. 460, 461. For some rods the section is made uniform throughout; in others, it is deeper at the center than at the ends. The advantage of this form of rod is that, with an amount of metal equal to that used for a rod with a solid rectangular section, its depth can be made greater than the depth of the former, and, consequently, it is stronger to resist the action of the centrifugal force. On the other hand, the opinion prevails, among a number of master mechanics, that this rod does not possess the required flexibility sideways, and we believe that, on this account, it is not generally adopted. A difference is also made by different designers in the distribution of metal throughout the transverse section; the proportions given in Fig. 464 we find sometimes adopted, whereas, for the same class and size of engines we occasionally find the proportions of the cross-section to be like those shown in Fig. 419.

The type of side rod shown in Figs. 462, 463, has been used on some railroads for a number of years, and is said to be one of the best type of rods in use. As will be seen, it is made deeper at the center than at the ends, but its thickness at the center is less than at the ends. In it are combined the best features of the rods shown in Figs. 458 and 460. On account of its increased depth at the center, it is stronger to resist the action of the centrifugal force, than the rod shown in Fig. 458; and on account of its decreased thickness at the center, it has a greater flexibility than the one shown in Fig. 460. But it is an expensive rod to make, and therefore we believe it is not as often adopted as its merits deserve.

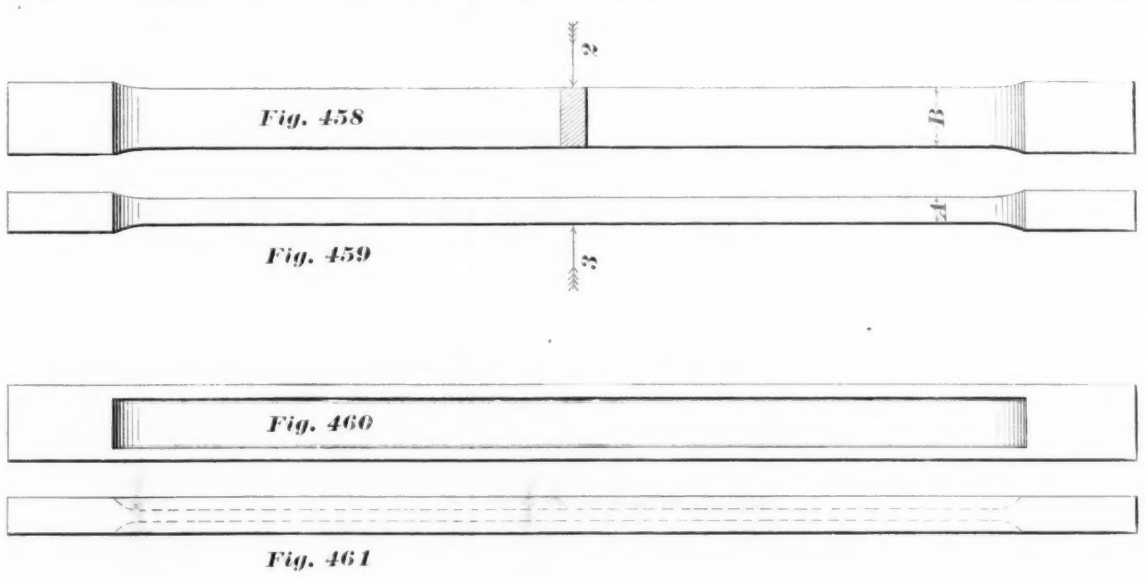


Fig. 458

Fig. 459

Fig. 460

Fig. 461

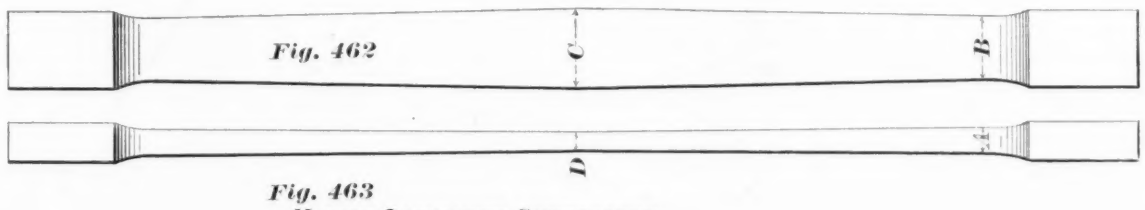


Fig. 462

Fig. 463

MODERN LOCOMOTIVE CONSTRUCTION.

Precautions Against Damage to Fire Apparatus by Freezing.

The Factory Mutual Insurance Companies insure only mills and manufacturing establishments equipped with fire apparatus to an extent which renders them independent of public fire departments. Their system of inspection is almost close enough to constitute a supervision of the property in respect to its defense against fire. In accordance with their custom, the following cautionary circular is distributed to their clients each November, and contains matter of general interest to all concerned in the care of private fire apparatus:

HYDRANTS—PUMPS—VALVES.

The warning given in previous years to prepare for freezing is now repeated.

Prior to the issue of the first circular on this point, hydrants cracked by freezing were common; now they are exceptional.

The work of only one inspector has been reviewed, in order to measure the progress in this matter. In 1878, before the issue of a special circular, he reported forty-two hydrants broken by freezing; in 1879, only two.

Many of the yard hydrants, and those connected with stand-pipes, are of the variety known as Y or branch hydrants, and are not provided with means of draining off the water when the hydrant is closed.

When the fire-pumps are used for inspection, or for the drill of the fire organization, water remains in the upper portion of such hydrants as were closed before the pipes were drained, and also forces its way into the upper portion of every hydrant that does not remain perfectly tight under the heavy pressure. The hydrants are generally tight enough to retain this entrapped water, and the hydrant-caps prevent its evaporation.

The hazard of a single broken hydrant does not lie so much in the possible deprivation of its use, as it does in the fact that, when water is forced into the pipes, there is a great risk of the hydrant breaking; and in most mill-yards such an accident would tap all the pipes, and prevent the efficient operation of the fire apparatus.

The possibility of such accidents can be obviated by opening all the hydrants when draining the pipes for the winter months, and closing them afterwards.

It is therefore suggested that each agent shall, either on receipt of this circular or at such other time as he sees fit to prepare for freezing weather, cause all the hydrants of the description named to be opened, the pipes drained, and the hydrants then closed. Rotary pumps should be emptied, if not submerged, by turning them backwards.

In shutting off the water from automatic sprinkler systems, where there will be danger from freezing during the cold months, care should be taken that the water is drained from all these pipes, and also that all persons concerned in the care of the mill should *know that such valves are shut*, and must be opened in case of fire under the sprinklers, in order that it will not be assumed that the system will be entirely automatic in its action over a fire. It is suggested that such valves should bear a notice, stating that the valve is shut, and must be opened in case of fire endangering the room which its sprinklers protect. All other valves connected with sprinkler systems are to be kept strapped (never chained) open as heretofore.

In this connection we also urge that all left-handed valves and water-gates be distinctly labeled, as many cases have been observed where the valves have been broken by an attempt to turn them the wrong way, even in the presence of our inspectors when causing them to be examined; some great disasters have occurred from the mismanagement of such valves, both in premises insured by us and also outside of our line of risks.

The want of similiarity in the direction of opening and closing valves is a great misfortune, that cannot now be remedied in all cases. In several instances mills have been wet down when the fire apparatus has been under test, because the persons in control were ignorant of the right method of opening and closing their own valves.

It therefore behooves the principal manager of every mill to see that every left-handed valve or gate is distinctly labeled and marked with an arrow painted in white, to indicate the direction in which it should be opened; or, what would be better, where there are only a few left-handed valves in a yard containing many others, to remove them entirely.

Cornell University.

We have received the *Cornell University Register* for 1888–89. It shows that the school is being steadily enlarged and improved, and also that the demands made upon it by those who, for themselves or their children, seek the higher education, are steadily increasing.

The number of students in attendance this year is 1,174, as against 1,010 last year. Several new departments of study have been added, and new professors appointed.

The Sibley College of Mechanic Arts is so full that the authorities have found it necessary to publish a statement that only about one hundred can be accommodated in each class, and that only those passing the best examinations will hereafter be received.

Prof. Thurston, who is at the head of this department, called upon us recently. He is evidently well suited with his work there, and is carrying it on with great enthusiasm. It is evidently pretty nearly the ideal life for such a man. He speaks in the highest terms of the character of the students attracted to his department. Their earnestness and devotion to their studies is not equalled in any other department of the university. They are usually quite practical, come there for a certain definite purpose, and pursue it diligently and earnestly.

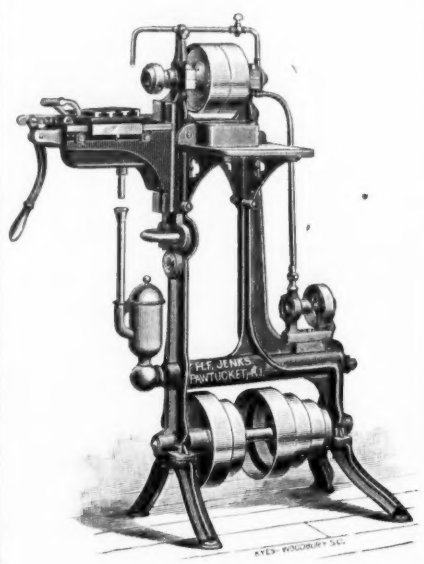
During our conversation, the subject of the university's wealth came up, and Prof. Thurston said that the prevalent idea, that Cornell University is very wealthy, is not true when all the circumstances come to be taken into account. Though it has a very large endowment, it must admit each year one student from each assembly district in the State without payment of tuition fees. The number thus received, when all the scholarships are full, is 512, besides which there are numerous scholarships and fellowships, the beneficiaries of which receive financial aid from the university in addition to free tuition. This absorbs the income from a large part of the endowment, and, the professor declares, renders Cornell one of the poorest instead of one of the most wealthy universities.

Prof. Thurston's friends will be glad to know that his health, which at one time was very poor, is now as good as could be desired.

The Preservation of Iron.

John Heald, the proprietor of the machine works at Crockett, Contra Costa county, Cal., has for some years been experimenting with a view to preserving exposed iron-work, and has demonstrated some things respecting this important matter that may be of great value. Mr. Heald, some years ago, had occasion to move a gas holder at Vallejo, and happened to notice on the old plates, which were badly corroded, that the "shipping marks" on the sheets were perfectly preserved. This led to the examination of other cases of the kind, where marking had been done on iron-work, and also to experimenting with turpentine and white lead as a first coating to prevent rust. It is found that when surfaces are coated with finely ground lead, thinned with spirits of turpentine, no corrosive action or scaling takes place, even when heavy coats of paint are afterwards put on the outside. Mr. Heald says that common paint mixed with oil is too thick to penetrate or close the imperfections of the surface, and penetrate beneath the scale where it exists, thus leaving places for corrosion to begin beneath the paint. With turpentine and white lead mixed thin, the very pores of the iron are closed. The interstices, to so call them, are too minute to receive the body which oil gives, but are closed by the thinner compound. This is the theory, but that is a matter of no consequence, so long as the fact is known.—*San Francisco Industry.*

One of the minerals that abound in this region is graphite, but for some reason hardly anything has been done hitherto in the way of developing and utilizing the deposits that are known to exist here. We learn, however, that a company has been organized to work a vein of this mineral that lies about a mile south of the Taylor mine, on the north hal of the northeast quarter of section 16, 49-33. The company is composed of Detroit capitalists, and they have strong hopes of making the production of graphite a profitable industry.—*Marquette Mining Journal.*



Improved Tapping Machine.

We present herewith an engraving showing a new design of tapping machine, which is also intended to do light drilling or thread cutting.

The spindle carrying the tap, is driven by means of two pulleys, which run on extensions of the boxes, to relieve the pressure on the shaft, and are connected to the spindle by friction clutches thrown in or out by the endwise motion of the spindle.

The knee is fitted to a vertical slide, upon which it may be moved by a screw and hand wheel. The table, which slides upon this knee, is provided with T slots, and is moved in and out either by the lever shown, or by the handle above. Its motion is limited by stops in either direction. A jig or other fixture may be bolted to the table, for holding the work, and, in tapping, the table advances until it comes in contact with the stop, when its motion is arrested and the spindle drawn forward until the clutch is thrown and the motion reversed.

The spindle is driven from a countershaft below, which is driven from another countershaft above, by means of stepped pulleys, three speeds being provided for.

When so desired, the lower countershaft can be driven direct from the line shaft, dispensing with the overhead shaft; in which case there is only one speed.

Provision is made for using abundance of oil, which flows from the table into settling chambers, from which it is pumped up and onto the work by a small rotary pump driven from the shaft below. The spindle is hollow, and long rods can be put through it and threaded, or the machine may be used for tapping nuts or threading bolts as well as for tapping holes in machine parts. Taps may be used from $\frac{1}{16}''$ diameter or smaller, up to $\frac{1}{2}''$, the friction clutches being made very easy of operation, to admit of the use of the smallest taps.

The spindle is 41" from the floor, and the floor space occupied is 20" x 36". The builder is Henry F. Jenks, Pawtucket, R. I.

Covering for Steam Pipes.

A non-conducting coating for steam pipes, etc., used for the past ten years with perfect satisfaction by a Boulogne engineering firm, is described in a recent issue of the *Revue Industrielle* as being conveniently applied and cheap; while it can be prepared by any steam user. It consists of a mixture of wood sawdust with common starch, used in a form of thick paste. If the surfaces to be covered are well cleaned from all trace of grease, the adherence is perfect for either cast or wrought-iron; and a thickness of 25 mm. will produce the same effect as that of the most costly non-conductors. For copper pipes there should be used a priming coat or two of potters' clay, mixed thin with water, and laid on with a brush. The sawdust is sifted to remove too large pieces, and mixed with very thin starch. A mixture of two-thirds of wheat starch with one-third of rye starch is the best for this purpose. It is the common practice to wind string spirally around the pipes to be treated, keeping the spirals one centimeter apart, to secure adhesion for the first coat, which is about 5m. thick. When this is set, a second and third coat are successively applied; and so on until the required thickness is attained. When it is all dry, two or three coats of coal-tar, applied with a brush, protect it from the weather.

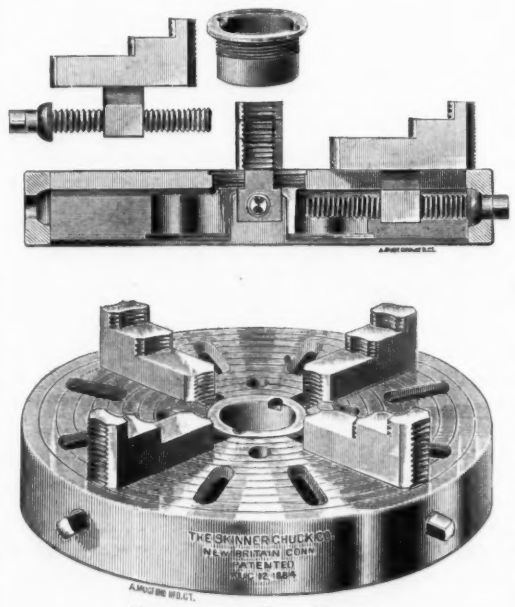
The following is from the *Milling World:*

"Late Minneapolis reports announce the restriction of flour production, and predict a shut-down in December. Buffalo mills will shut down for several weeks between this time and the holidays. Milwaukee and St. Louis mills also propose to restrict output very largely during the closing weeks of the year. It is proposed to cut down production to stiffen prices and enliven trade."

If the mills cease to produce flour, there is not much doubt about the stiffening effect, but just how it is to enliven trade is not so clear.

New Independent Reversible Jaw Chuck.

The Skinner Chuck Co., of New Britain, Conn., have brought out a new independent reversible four-jawed chuck, the construction of which is shown by the accompanying engravings. In this chuck, especial attention has been paid to reducing the weight as much as possible, consistent with strength and rigidity, with a view to lightening the load on the lathe spindle and making the chuck easy to handle. In some of the larger sizes, the weight has been reduced from former designs more than one-third. At the same time, tests show them to be amply strong and rigid. The ring and the bearings which take the thrust of the screws are made especially strong. Into the center of the chuck a hardened steel bushing is screwed, against the smooth part of which the inner ends of the screws bear; this bushing taking the thrust when the jaws are moved outward. A wrench is furnished, by which the bush is removed when it is desired to reverse the jaws. The screws are of steel, and the jaws of steel case-hardened. They are made in all the standard sizes, from 4½ to 24 inches, the latter size weighing 100 pounds.



Reversible Jaw Chuck.

The railroads centering at New York have struck the canals hard this year, in the matter of freights. There has been a determined effort to kill the canals, at a big sacrifice on the part of the railroads. It will be interesting to note the railroad tariffs after the closing of the canals and the Hudson river.

A bill has been introduced in the Senate for the construction of two steel rams, to be armed with dynamite guns.

With the Correspondents.

By Jarno.

REAMER—MEASURING SCREWS—IN THE DRAWING-ROOM—TURNING WITH A MILLING CUTTER, ETC.

The editor of the American Machinist has handed me the following letter:

"Will 'Jarno' please give us his method for polishing the face of reamer teeth? It seems to me that a good surface on the face of a tooth is almost as essential as a good surface on the top. I have seen the surface ground with emery wheel and polished with emery cloth, but would like to know a better way if there is one." W. R. G.

This is a pertinent question. A smooth surface is almost as important on the face as on the top; in fact, we can hardly say that there is any difference in importance, because, if either is rough, the reamer will not make a smooth hole. Though the same roughness upon the face of a tooth is not so exactly reproduced in a hole as that upon the outside, yet, to insist upon this as a reason why the face can be left rough, would be too much like making a distinction without a difference. The method spoken of by W. R. G. is good. Where a number of reamers are made, the polishing can be quickly done with a leather wheel, upon which is put emery and oil. In a shop where reamers are not manufactured for the market, the wheel can be run in a speed lathe. If the lathe has a chuck, I would let it hold the wheel arbor rather than drive with a dog. If a dog leaves a speed lathe and goes after a man, he may have as much discomfort as if a dog were after him when he is in a hurry to get over a stone wall. Since a lathe dog put out the eye of my acquaintance as the arbor left the centers, I had much rather see one quietly hanging upon a pin, than to use it for driving anything in a speed lathe. Only the leather wheel need be used after hardening a reamer, if the tooth faces are quite smooth before hardening. If the teeth of the fluting mill be beveled on the side that cuts the faces of the reamer teeth, they will generally be smooth enough not to need any finishing, except polishing with a leather wheel, after the reamers are hardened. The beveled fluting mills can be obtained in the market. An excellent finish can also be obtained with an oil stone, but it takes rather too much time. The faces should be finished before the tops are ground.

I will add something about reamers that I fear the editor may cross out with his blue pencil, because, to let it go, might teach his readers a thing that will lead to questionable practices. A solid reamer can be made to size a few holes larger than itself, by rubbing one or more tooth faces with some hard piece, like a scratch awl or a burnishing tool. This will turn up a burr that cuts, but soon wears away and leaves the tooth faces rounded, and not in good condition for future cutting. The one who tells me this thinks it is sometimes allowable, if we want to ream a hole in cast-iron where oil prevents the reamer from taking hold, especially if the hole be tapering.

The witness that told me of the workman who sized a reamer with a brick, thinks that I passed over his testimony rather too slightingly, and that, if I expect a man to show a brick to prove his words, I am in a fair way to become as unfair as some of those *Century* writers. This is the brick story: A workman new in a shop was asked to make several smooth holes, each of the same size. There was no reamer of that size. He found an old one that had been laid aside, which was too large. With a hard-burnt brick held upon the tool carriage of a lathe, he sized the reamer and then relieved the teeth with an oil-stone. The reamer did good work, and the man was at once ranked as an excellent workman.

In the American Machinist of Nov. 3, Pedro shows a method of measuring screws that have an even number of threads, which

he says is better than the one shown by me in the issue of Sept. 29. Pedro is right; his method is better than mine for the reasons he gives, and also for a reason that he does not give. The advantage of his method that he does not point out is that, with it, he can measure the depth of a thread groove before another one is cut, and hence he can finish each groove at one operation. With the method that I suggested, two grooves of a double-threaded screw must be cut before measuring, and if there is a difference in the depths of the grooves, the caliper will not measure it. If the screw be four-threaded, or quadruple-threaded, the four grooves must be cut before measuring by my method.

Several correspondents speak of saving expenses in the drawing-room. Of course, the pattern and the machine shop should be helped. One tendency of man is to make rules to govern future action, so as to save as much as possible any exercise of his reasoning powers. Of all men in mechanical life, I think the draftsman can be the least guided by rules. Yet he should have a few rules. Among the things of general utility are: Drawings should be of standard size—their titles should always be in the same place—in lettering, no straight edge or dividers need be used. The machinist dislikes to have upon a drawing, any figures that are not intended for him to use. I think that he could soon learn to take no notice of figures that are made only for the pattern maker, as well as the latter has already learned not to be confused by the machinist's figures. It is well to figure the thickness of a rib and also of a web. In a quarter size drawing, a heavy line, slightly misplaced, may lead the pattern maker to vary one-eighth of an inch or more, from what the draftsman intended. When a large curve is drawn it is a convenience to the pattern maker to have the radius shown. The length of the radius need not always be given, but if simply the radial line is drawn it saves the pattern maker's time in finding the center. Should the radius of the curve be so long that the center does not come on the drawing, it is well to draw a radial line to the edge of the paper, and figure the length of the radius. When a drawing shows pieces to be chucked, it should also show in which direction to chuck them, a good way being to draw an arrow pointing through the hole, and to write the word "chuck" near the arrow. Measurement lines should be made either black, or heavy enough to clearly show in the blue print. But little can be said in favor of having, upon a drawing, lines of any color except black.

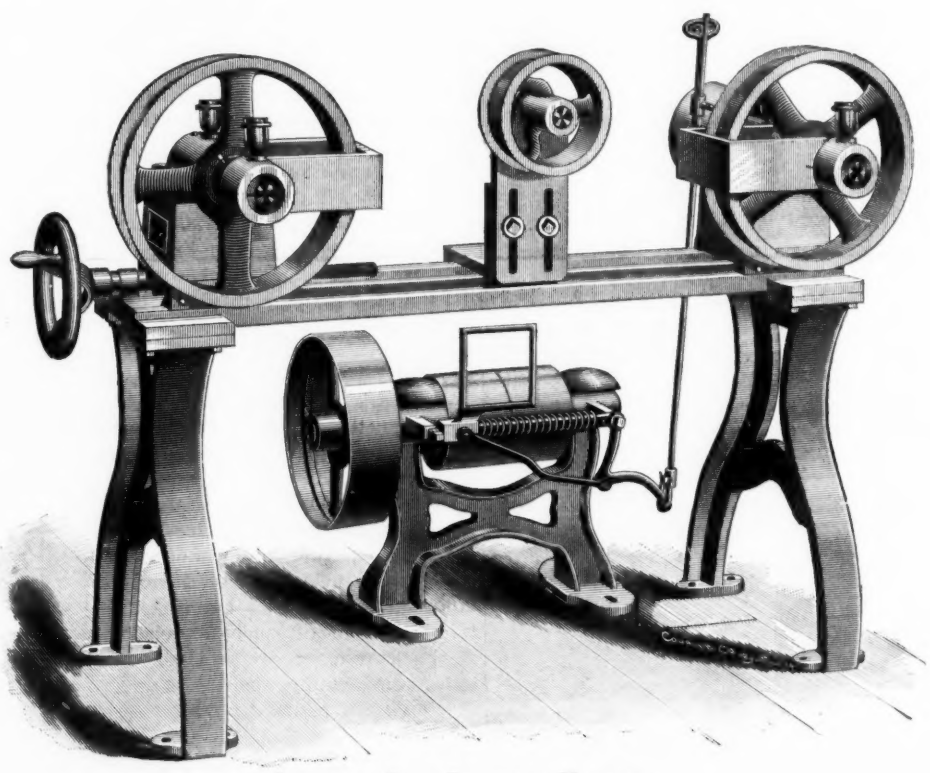
In the AMERICAN MACHINIST of October 27, S. W. Powel and W. L. Cheney propose the sizing of worm gearing by diametral pitch. This would be a great convenience. In many of the lathes now in use the change gears differ by seven teeth, each gear being some multiple of seven. In such lathes the addition of change gears that are each a multiple of 22, as 44, 66 and 88, to be placed on the spindle stud, would enable us to cut most worms to diametral pitch, without the addition of a pair of transforming or translating gears.

The AMERICAN MACHINIST of September 22 speaks of planing rack teeth with a cutter, fastened in a clamp that is held in the tool-post, the credit of which is due to Mr. J. H. Ferguson, of New York. Excellent. I would suggest, by way of a rider, that with the cutter we can also turn the rack teeth, sometimes made around the post of an upright drill. A round-edge cutter is also good for turning fillets. With a common lathe tool it takes some little time and skill to turn a good fillet—one that does not catch the eye as being Bunchy. Of course, if we have a good lathe tool, we can turn a good fillet, but a cutter is more economical.

I have seen a curious case of the behavior of steel pieces in hardening. They were small wrenches, about $\frac{1}{8}$ of an inch thick, with handles $\frac{3}{8}$ wide and two inches long, cut from a sheet. In hardening, more than one hundred handles have split into two parts, each about $\frac{1}{16}$ inch thick. In some wrenches the split runs the whole length of the handle. This is thought to have been caused by too much rolling of the steel when it was cold.

In the issue of November 24, W. H. Booth implies that the use of an odontograph, for obtaining the forms of gear teeth, is a "make-shift"; that is, a temporary expedient that may be deceptive. I do not understand that any odontograph is a "make-shift," but that it is an approximate method, which can be accurately applied. The difficulty of applying an exact method may lead to as much error as the incorrectness of an approximate method that can be easily applied. The methods given in two books, published within a few years, are certainly very nearly exact, and are good enough for practical purposes. Gears made upon any principle may be noisy. Of course, if they are noisy they are not perfect. But I have seen gears in twenty-four machines, made at the same time and in the same conditions, some noisy and others still, yet it would trouble a man to pick out the noisy ones without making an actual trial by running. The gears did not *look* noisy.

Will T. P. Farmer permit a small rider to his "Anatomy in a Machine Shop," issue of October 20? A hand-wheel too near another part of a machine is a fruitful source of pain to the operator, that for a moment forgets the narow space and wedges his hand therein. A projecting piece on the reciprocating part of a machine, like the shipping-dog on the table of a planer, may make an uncomfortable battering-ram. Being so near the operator, it is liable to attack his legs at any time. Where the design of a machine makes such a ram necessary, I would suggest the addition of a leg shedder, after the manner of a cow-catcher upon a locomotive. The operator of this machine can, at any time, tell the height of the table by measuring the length of his leg below the sore place. There is a planer in the market that can be shipped with one foot, as the operator stands with the other foot upon the table. This planer is much liked.



IMPROVED BELT POLISHING MACHINE.

Improved Belt Polishing Machine.

The illustration shows an improved machine for running endless belts for polishing metallic and other articles built by the Springfield Glue and Emery Wheel Co., Springfield, Mass.

The points in which the machine differs from others of its class, are in the yokes which pass around the belt wheels to support outer bearings for the shafts, the hubs of the wheels being made to just fill the space between bearings, and prevent end motion. The shafts are straight and plain, and run in straight plain sleeves, split and capable of being tightened to take up wear.

As there is practically no wear upon any part of the machine except these shafts and sleeves, which are easily replaced, great durability is secured.

One of the wheels is movable along the bed by the screw shown, to secure any desired degree of tension. The small wheel in the center is also adjustable along the bed, and vertically, or may be quickly removed when not needed. Its office is to prevent sagging of the belt.

The height from the table to the center of the wheels is $8\frac{1}{4}''$, distance from center to center of wheels $36''$. Belts may be used up to 8 feet long, and from $1\frac{1}{2}''$ to $4''$ wide, according to order. Floor space occupied, $45'' \times 18''$; weight, 425 pounds.

Force in the Steam Engine and its Relation to Smooth Running.

BY PROF. JOSEPH TORREY.

SEVENTH PAPER.

We are now ready to calculate the amount of inertia force developed during each of ten equal divisions of the piston stroke. In doing this we shall calculate them for an engine of the following dimensions: Stroke, 1 foot; revolutions per minute, 60, or one revolution per second; length of connecting rod = 6 cranks; weight of reciprocating parts (piston and rod, crosshead, crosshead pin, and connecting rod), 1 pound. I take these dimensions, because it will give us results that, by multiplying by a simple factor, can be made to fit any engine.

Having drawn a line to represent length of stroke, and divided it into ten equal parts, we calculate the amount of inertia force for each division from three things: First, the weight of the reciprocating parts; second, the velocity acquired or added during that division; and third, the time occupied in passing over the division, or, in other words, the time occupied in acquiring or adding this velocity.

We have seen previously how to find these elements for any engine, and, knowing them, we make use of our formula, which was given for calculating the amount of force needed to impart or add a given velocity to a body in a certain time:

$$F = \frac{W \times V}{T}$$

and the result will be the number of force units required. It is much better and more convenient to have the result in fractions of the weight of the reciprocating parts, as this gives us our forces in pounds, then by dividing by the number of square inches in the piston area we obtain the necessary pressure in pounds per square inch.

We will now proceed with our calculation of the inertia for the first tenth of the stroke.

The first question is, "What is the piston velocity at the beginning and end of the division, or, what velocity has been acquired or added during this division?" Referring to our table of velocities, given in the last paper, we find that the piston velocity at the beginning of the first division is 0, and at the end, .64 of the crank-pin velocity. Now what is the crank-pin velocity? The engine makes one revolution per second, and its stroke is one foot. Therefore the crank-pin will travel $1 \times 3.1416 = 3.1416$ feet per second (since the circumference of a circle equals its diameter multiplied by 3.1416). Now, since the crank-pin travels 3.1416 feet per second, and the piston is traveling .64 as fast at the end of the first division, the actual speed of the piston at that point will be $3.1416 \times .64 = 2.0106$ feet per second. This, then, is the velocity acquired by the piston during the first division. Now, what has been the time occupied in acquiring this velocity? Referring again to the table, we see that the crank angle at that point was 34°, and since the crank-pin travels through 360°, or the whole circumference, in one second, it will travel 34° in $\frac{34}{360}$ second, or .0944 second. This is the time. Now, substituting for V, 2.0106, and for T, .0944, and for W, 1; since the reciprocating parts weigh 1 pound, we have

$$F = \frac{2.0106 \times 1}{.0944} = 21.04 \text{ force units.}$$

Dividing this result by 32.16 gives $\frac{21.04}{32.16} = .654$, which is the force expressed as a fraction of the weight of the reciprocating parts. In this case, where $W = 1$, the force is seen to be .654 of a pound. This is the total pressure in pounds at that point; not the number of pounds per square inch.

Now this force, being the average force developed during the first division, is the real force at the center of that division, and must be laid off to scale on a line drawn perpendicularly through the middle point of the first division. We then proceed to the second tenth of the stroke.

At the beginning of this tenth the velocity of piston was 2.0106 feet per second. At the end it was $.847 \times 3.1416 = 2.6599$ feet per second. Hence, during this division there has been a velocity of $2.6599 - 2.0106 = 0.6493$ feet per second, added to the piston. Now, what time has been occupied? The crank angle was 34° at the beginning, and 50° at the end, hence, during the division the crank-pin moved $50° - 34° = 16°$, and this distance was traveled in $\frac{16}{360}$ second, or .0444 of a second. This is the time. Then the inertia force for the second division would be $\frac{0.6493 \times 1}{.0444} = 14.29$ force units; and this, divided by 32.16, gives .444 of the weight of the reciprocating parts.

In exactly the same way would we calculate the force for each of the ten divisions, remembering only that after the 5th division the velocity begins to be retarded by the crank motion, and the question for each division after that one, accordingly, will be: How much has the velocity been decreased during this division? The rest of the calculation would be just the same as before.

The force found for the second division would be laid off on a line drawn perpendicularly through the center of that division, and would be measured above the stroke line, since it represents resistance to motion. After passing division 5th, the forces are laid off downwards from the stroke line, since they represent resistance to retardation.

Proceeding in this way, we should find that we would come out with a force laid off at the center of each division of the stroke. It is desirable to know in addition the inertia at the very beginning and end of the stroke. This can be done pretty accurately as follows:

Considering the inertia at the back end at the beginning of the forward stroke, proceed as follows: First, average the forces at the

middle points of the first and second divisions and we have $\frac{21.04 + 14.29}{2} = 17.665$, which is evidently the amount of inertia at the end of the first division. We know the amount of inertia at the middle of the first (21.04), and since the inertia at the middle of the first is the average of the forces at the beginning and end of the first, we can find the amount at the beginning by the formula $\frac{X + 17.665}{2} = 21.04$, where X is the unknown amount of inertia at the beginning of division 1; from this we get $X = (21.04 \times 2) - 17.655 = 24.42$, which is very nearly the true force at the beginning of division 1.

Then, at the other end of the stroke, average the inertia for the 9th and 10th divisions, and we get $\frac{13.50 + 15.77}{2} = 14.635$, which is the inertia at the beginning of division 10. Then as before, since the inertia at the middle of 10 will be the average of that at the end and beginning, we have $\frac{X + 14.635}{2} = 15.77$, whence $X = (15.77 \times 2) - 14.635$, or 16.90, which is the amount of inertia force developed at the end of the forward stroke.

The following table gives the inertia forces at the middle of each of the ten divisions of the stroke for an engine of the dimensions given with it. The forces at the ends of the stroke are also given.

Table Showing Inertia at Each End of Stroke, and at the Middle of Each Tenth of Stroke.

	Ordinate.	Inertia in Force Units.	Inertia Forces in Terms of Wt. of Recip. Parts.
Back End.	0	24.42	0.759
	1	21.04	.654
	2	14.29	.444
	3	9.90	.307
	4	5.16	.160
	5	0.47	.011
	6	3.64	.113
	7	7.41	.230
	8	10.76	.334
	9	13.50	.419
Front End.	10	15.77	.490
	0	16.90	.556

For an engine of 1 foot stroke; 1 lb. wt. of recip. parts; 1 rev per sec.; con. rod=6 cranks.

To use this table for any engine whose connecting rod = 6 cranks, we must remember that the inertia will increase just as the weight of the reciprocating parts increases, directly as the length of stroke, and as the square of the number of revolutions increases. That means, if an engine were developing a certain amount of inertia, and the weight of reciprocating parts were doubled, the inertia would be doubled. If the stroke length were doubled, the inertia would double, and if the number of revolutions per second were doubled, the inertia would be increased four times. If the velocity were made four times as great, the inertia would be sixteen times as great, etc. Hence we have the following rule.

Square the number of revolutions per second, multiply together this result, the length of stroke in feet, and the weight of reciprocating parts in pounds. Divide the product by the area of the piston in square inches. Multiply each of the numbers in the second column of the table by the result thus obtained, and the products will be the forces developed in pounds per square inch of piston area, during each of the ten divisions of the stroke.

The table given above was worked out by the measurement methods mostly, and as the work has all been done in such intervals of time as I could secure from a very confining business, they are probably not altogether accurate. I would advise everyone who is keeping track of these papers and wishes to profit by them, to make a table for himself, if for no other reason, on account of the grasp and insight into the subject that will certainly result. If the principles are once clearly understood, it will be a comparatively easy matter to apply them to the study of particular engines.

In the next paper the inertia curve will be considered, and its place in the indicator diagram.

LETTERS FROM PRACTICAL MEN.

One Way of Tempering.

Editor American Machinist:

In reply to Question 526, P. G. R., of Marshall, Tex., asking for a process for tempering spring washers: If he will take a quantity of soft water and make it about blood warm, and then heat his spring washers to a heat that will take temper, and drop them in the warm water, the springs will come out white, like all steel will when it is hardened; then take a pot, or a large ladle, put the springs in it, cover them with raw linseed oil (the boiled oil is better), put the pot or ladle on the forge or furnace, blow slowly until the oil comes to a boil, then it will take fire; let it burn; it will make a big blaze. As soon as the blaze goes down, and you see that the oil is all burned, let it set for a few seconds, then pour the whole business into cold water. Your springs are tempered, may be filed if necessary, will stand freezing, and will not break. This is not a costly mixture, only what soft water and linseed oil may be used. This is my own receipt and discovery, and one that will not fail you.

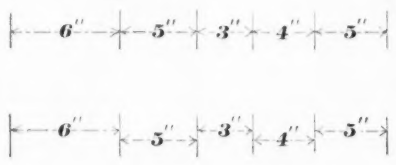
I notice in your paper very often, someone inquiring how to temper a drill or tap, so it won't crack. My way of doing a job of tempering a drill, tap, reamer or screw-plate, is to melt prussiate of potash on the piece I want to temper, while heating the article, then plunge it into water. Heat a piece of gas-pipe if for a tap, reamer or drill, and hold the article in it until the right color comes, which any good machinist knows. The potash is to prevent the tool from cracking; it will cause it to work free when using the tool, and will give it a finer finish.

WM. D. TROUTNER.

Dimension Lines on Drawings.

Editor American Machinist:

In my letter, appearing in Dec. 8 issue, I did not intend to refer to full or broken lines, as you make me do, but to the location of the arrow points. Text book rules say make dimension lines as in upper cut.



I do it as in lower cut, and I ask again, which is better on a soiled drawing or dark blue print? W. S. ROGERS.

Boiler Explosions.

Editor American Machinist:

In your columns I have already drawn attention to the great differences between the allowed pressures in boilers in America and England. Whilst I consider that in America, especially on the Mississippi cargo boats, a dangerously high pressure is allowed, I think also that English practice is too cautious, and even positively wasteful of material. In a letter addressed to *Engineering* I advocated for steel boilers of 27-ton steel (60,480 pounds) and double riveted a working pressure of $P = \frac{20{,}000t}{D}$. This is considerably higher than usual practice here, which also allows nothing more, even when steel of higher tenacity and proper ductility is used.

Since my letter appeared, I have been approached personally by a gentleman connected with one of the leading boiler insurance companies, and my attention drawn to the relative loss of life from boiler explosions in England and America.

In the United Kingdom, in the year 1887, there were only 33 explosions, which resulted in the death of 21 persons and injury to 39 others. In the year 1886 the explosions numbered 32, and killed 30 persons, injuring 57. From the report of the Hartford Steam Boiler Insurance Company, it appears that in 1887 there were no fewer than 198 explosions in America, where the amount of steam-power is about equal, it is supposed, to that of Britain. These 198 explosions killed outright 264 people, and injured—many fatally—388, a grand total of killed and injured nearly tenfold the British rate.

A full third of the English explosions in 1887 were of small vertical boilers, a class usually found in out-of-the-way places, where attention is bad. An examination of the American list proves that nearly two-fifths of the American explosions took place in saw mills and other wood-working establishments. These number 73; miscellaneous come next, with 27, and third on the list come portable agricultural and hoisting boilers, and so on, the list closing with one at textile manufactories.

This is what one would expect; saw mills head the list, and, I was about to add, very properly. The boiler of a saw mill is exposed to great risk. In the first place, it may be—in America—far from grace in the shape of a repair shop, and hidden deeply in a dense forest country. There is usually no call to save fuel in a wood-working establishment, and any fool who can shovel in slabs and waste timber is "good enough to look after a saw mill boiler." It is just these waste-wood shovelers who are careless of the water level, and who think they have made a grand discovery, when they find out that, by hanging the scrap heap onto the safety valve lever, the engine will do double work. After making due allowance for the difficulties inseparable to so large and thinly settled a country as the United States, it certainly does appear that the proportion of explosions is out of all good reason. At the same time, I am not inclined to put down the difference to the higher working pressures to the extent my friend here would seem to indicate. Explosions are by no means always due to actual nominal weakness of the boiler, so much as to such causes as improper working.

The almost universal externally fired boiler of America is not common in England, where external firing is rightly looked upon as dangerous, and I am decidedly of opinion that a rapid diminution of explosions would follow the abandonment of this system of working, which has so much to recommend it in America, both on the score of simplicity and cost. Most boiler explosions which do occur would probably do so despite all rules as to pressure, for they are simply the result of willful overloading of safety valves, or gross ignorance, which no rules can provide for, and such explosions must of necessity be far more frequent in America, with the conditions I have pointed out as existing in frontier settlements more especially, more sharply defined than in England, where it is stated at least half the boilers are under more or less skilled and independent outside inspection. Hence, though I would not advise the higher limit of American pressures to be anywhere applied, I still consider that I am fully warranted in calling for more liberal allowances in England, where high class boilers are frequently taken out, to make room for others of greater strength, which would still be more than sufficiently strong in America, even in the opinion of the most cautious.

I know of some boilers near here which have single-riveted—2-inch pitch—shells 84 inches diameter. Properly constructed as to dome connections, such boilers would be here looked on as suited for 50 pounds' pressure at most, and being old and hand-riveted, would be preferred at 45 pounds. They were, however, fitted with large domes, the hole in the shell being cut out the full size of the dome, and unstrengthened. Now, according to my English ideas, the very outside pressure in such boilers should be 40 pounds, and indeed, 30 pounds seems better for such a dome attachment. To my knowledge these boilers worked for years at 60 pounds, and when I became aware of their faulty construction, I cleared out of that locality as soon as possible. As no word of any explosion ever reached me, I have thought they must be now removed, but am making inquiry to learn.

I ought to add, that, though inspected by a boiler insurance company, they were not taken as a risk, being considered and reported as unsafe and over-pressed.

I give the example, so that American engineers may express an opinion on the pressure they would consider suitable in this case. As they did not burst, or have not yet burst, we cannot say what margin of safety they possess, but it must be very small at 60 pounds. It is not, of course, for such boilers that I favor greater pressure allowances, but for high class drilled work of good steel by reputable makers. W. H. BOOTH.

Manchester, England.

Piece-Work.

Editor American Machinist:

I have been reading with much interest your article in the issue of Nov. 24, on "Piece-work." As a planer hand of twenty-four years' experience, I feel entitled to express my opinion.

As you refer to politics, I will take the same liberty, and say I voted for "Protection," and now I *write* for *protection*.

Protection, I mean, from a further reduction of wages for machinists; for as sure as piece-work is adopted in a shop, just so sure there is a gradual fall in prices of piece and day-work. My experience has been that such is the case, and that it is natural.

One or two incidents will, I think, illustrate my meaning. Some years since I secured a situation, and worked perhaps two months, receiving $3.75 per day. The proprietor then wished me to take the work by the piece, and said he paid $20 for the planing of one size machines, $18 and $15 for two others.

I took the contract, but soon learned that he had reduced the prices by $5 on the first, $2 on the second and $3 on the third. On being asked about it, the proprietor said, "The other fellow made too much money out of us." So there was reduction No. 1.

After planing two lots of the $20 machines, I was told there would be ten machines in the next lot, and that the price would be $18.

With the improved methods I had introduced, and hard work, I brought the cost of planing down to a few cents over $10 for each machine, leaving me $8 profit. Then I was told that I could not have over $15 each, and the result was, we parted.

Now, Mr. Editor, if that man had been paying $25 for so much work year after year, and was satisfied, why did he cut me down to $15?

I think I can answer; he did it to illustrate human nature, or, as you express it, "supply his wants with the least possible exertion."

During the time I worked for him there had been no reduction in selling prices; on the other hand, a rise, if anything. It was in '68, '69 and '70.

I have taken no piece-work since, for I saw the effect, and resolved not to take any more dollars out of my body to put half into my pocket and half into my employer's, and at the same time establish a lower rate of pay for my successor.

There is this fact that cannot be gainsaid—every manufacturer knows just the time on each piece, and every shortening of that time is noted, and the next man is looked to to lower it, if possible.

You speak of the double responsibility of a foreman who serves as foreman and inspector. What will be the result in the shop where I now work, where the foreman receives a *percentage* on all machines completed?

When a man has worked a few years in a shop, he should be able to know what he is worth to his employer, and, if receiving that, should be man enough to earn it, and a little more, so that he may have the face to ask for more.

A general adoption of the "piece-work" system means a general reduction in day-pay prices. DAY PAY.

Thinking and Wages.

Editor American Machinist:

In your issue of Dec. 1, "Tramis" seems to express the idea that the best way for a young man to get along in the shop, or in any mechanical pursuit, is to think solely of his work, and of improving himself in his chosen vocation, and to give no thought to the question of wages.

This may be all well enough for some men, but it will not do for the vast majority

of men. Most men must think of their wages, and how they can increase or maintain them. There are men to be met with who are mechanical enthusiasts, and who can't think of much else if they try. If such a man happens to possess practical mechanical ability at the same time, the question of wages will take care of itself so far as he is concerned. But men of such exceptional ability, that they can safely trust the wages question to take care of itself, are rare, and are born, not made. No matter what the general standard of ability may be, there will, in the nature of things, be many who are inferior to the few, and it will always devolve upon the many to look closely after the matter of wages, for no one will do it for them; and it can be depended upon that the other side of the matter will be looked after by those who pay wages.

The idea that work is in itself desirable, and that men should work for the sake of work, may do well enough as a theory, but it is a condition which the average workman has to face; and unless he sees to it that he receives the highest possible wages in return for such work as he can do, his wife and babies are liable to suffer for lack of the common comforts and necessities of life.

Mere work is not in itself desirable, it is that which men get in return for their work which is desirable.

The goods of the manufacturer, ready for sale, represent the labor of himself and that of his workmen, which latter has been or is to be paid for. It is recognized as entirely proper and right for him to make use of every fair and honest means of increasing or maintaining the price at which they must be sold. Giving no thought to the prices of goods would not work very well for a manufacturer. When I have anything to sell, I expect to try to get the highest price for it, and I do not complain if others having things to sell to me do the same thing, whether it is goods or labor they have to sell, so long as there is no monopoly, but open and free competition.

T. A. PANDIE.

Milling Machine Centers and Pening.

Editor American Machinist:

The letter of Mr. Kirchner, published in your issue of Dec. 1st, under the title, "A Milling Machine Trouble," reminds me that I saw something in a shop, not long ago, which would indicate that there are other things besides pening, which may cause milling machine centers to be out of line with the spindles.

What I saw was a chap drilling the hole for the center in the casting which goes upon the overhanging arm. It had been fitted to the arm, and he had the milling machine belted up, and a full length twist drill in the spindle. Things were left loose enough to allow of the casting being slipped back towards the drill, and it was fed through by the cross motion of the table, a piece of iron being bolted to it which, coming into contact with the casting, shoved it along. After the hole was drilled in this way, the casting was taken to a vise, and a reamer, used by hand, finished the job.

Now, if Mr. Kirchner happened to use a milling machine having the hole for the outer supporting center made in this way, it would be hardly necessary to look to pening as the cause for the center being out of line, because not one in a thousand would be true to begin with.

I am inclined to think that the trouble with Mr. Kirchner's machine came from the fact that the builder failed to take the proper means to secure a true hole, and that, when Mr. Kirchner put a reamer in the spindle of the machine, and reamed the hole in its proper position, he simply did what the builder should have done, but failed to do. And a small boring bar with a single-ended cutter should precede the reamer, not a drill, except to make way for the bar. Still, I do not underrate the evil effects of accidental or careless pening, for I have seen and had reason to lament its disturbing influence too often.

There are too many users of machinery, who, while they would know enough to avoid abusing a sliding surface upon a tool or machine, do not hesitate to hammer and bruise any other surface, especially if it is unfinished, seeming to think that, as long as it is not a working surface no harm is done, overlooking entirely the effects of the pening. And yet it often happens that as much harm is done to a machine by hammering or otherwise abusing a rough and unfinished surface, as would be done by hammering a finely fitted sliding surface.

In connection with this matter of pening, my first lesson regarding it may not be uninteresting. It was in my young days, when I had much more to learn than I could have been made to realize. I was running a planer and doing the general jobbing and repair work in a large establishment. They had in another department a good deal of wood-working machinery in use, and along with the rest a double-headed frizzer. It had a large table of cast-iron, which was about ¾" thick, and the man who operated it used a hammer for pounding the pieces of wood which he was working, onto the spurs of the form. He always laid the hammer down on the table in the same place, which was back of and about equi-distant from the heads, and when I was called in to fix matters, the result of laying that hammer in the same spot hundreds of times per day for several years was apparent, in the condition of the table, which was "humped up" in the middle so badly that no good work could be done on it. I was to put it on the planer and plane it true again, and, perceiving that it would be made too thin in the middle if planed without first straightening it, I was directed to turn it over and pene the under side to bring it nearly straight before taking a cut over it. Taking a hammer, I soon succeeded in getting as much tension in the under surface as there was in the upper, and the table was nearly true. I then fastened it to the planer-bed, and began to plane it. As soon as the tool took from the top surface the effects of the pening there, that which I had done with my little hammer on the under surface, having no longer anything to counteract it, began to show its effects by drawing the table down in the center, which it did to an amount about equal to its former altitude. I did a good deal of hammering, filing, and planing on that table, and never got it as straight as it should have been. But while I was working on it, I had an opportunity to study the subject of pening, and ever since have had a vivid idea of its power for evil in the machine shop.

FAY.

Bachelder's Adjustable Spring Indicator.

We present herewith a perspective and a sectional view of an indicator which employs but two springs for a range of pressures from 10 to 100 pounds.

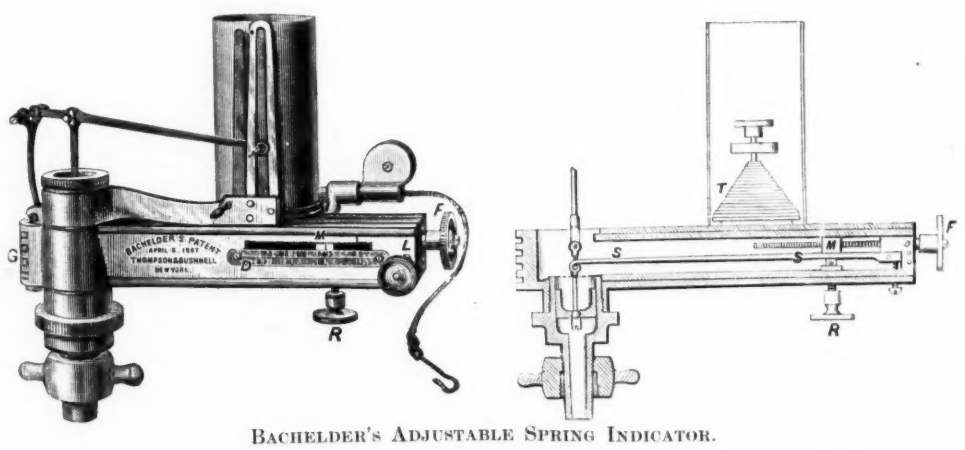
The usual spiral spring is in this indicator dispensed with, and a straight, flat spring substituted, the effective length of which may be varied to adapt it to various steam pressures.

The manner of doing this is shown in the sectional view, where *S* is the spring, and *M* a block, which is moved along the spring by the screw and milled head *F*, and clamped firmly in any position by the screw *B*. It then becomes the fulcrum, or point from which the spring vibrates, and, being moved to the left, the spring is in effect shortened, and its resistance increased, and *vice versa*. A scale is attached to the outside of the case, by means of which the proper adjustment for any given pressure is indicated. The manner of attaching the spring to the stem is shown, the stem being attached to the piston by a ball joint, to allow for the curvilinear motion of the end of the spring.

Above the spring there is another joint, which allows for the motion necessary to carry the pencil in a straight line. This is accomplished by a slotted guide, in which a small roller runs, which is attached to the end of the pencil lever, and through the center of which the pencil passes.

The range of the lighter spring is from 10 to 25 pounds, and the heavier from 30 to 100.

The entire side of the case upon which the scale is fastened opens upon a hinge which is at the left, exposing the entire mechanism, and steam can be admitted to the instrument when it is thus open. The screw *L* holds the hinged portion of the case in its place, and also serves to force it open, by being removed and screwed into a hole above. The guide pulley for the cord can be swung into any desired position to suit circumstances. The details of the instrument seem well carried out, and we see no reason why it should not meet with favor amongst engineers. One of these instruments has been in use at the fair of the American Institute recently, and some diagrams which we saw, taken from the Whitehill-Corliss engine there, are very creditable both to the engine and to the indicator. Two diagrams were taken upon the same paper, one with the spring set at 50 lbs., and the other at 40 lbs. The ability to do this might, under certain circumstances, be advantageous, especially in checking the accuracy of the spring. The indicator is made by Thompson & Bushnell, 120 Liberty street, New York.



BACHELDER'S ADJUSTABLE SPRING INDICATOR.

Engines of the Steamship "Falls of Inversnaid."

We abridge from *Engineering* the following, in relation to the engines of a steel cargo steamer, built by Russell & Co., Greenock, Scotland.

The "Falls of Inversnaid" has been fitted with a set of Rankin's patent disconnective quadruple-expansion engines. . . . . There are four cylinders 18 in., 26 in., 36 in., and 52 in. in diameter respectively, with a stroke of 39 in., arranged tandem fashion over a double-throw crank-shaft. The high-pressure cylinder is placed above the first intermediate, and the second intermediate cylinder above the low-pressure, so as to make two virtually separate engines, either of which may be operated independently at sea, in the event of the other breaking down. In furtherance of this important facility, a reducing valve has been fitted to the low-pressure half of the engines, to supply steam direct from the boilers, and a special exhaust pipe has been led from the high-pressure half to the waste steam pipe. This valuable principle of duplication has been carried into effect throughout the engine department, as there are two separate main boilers instead of one of the double-ended type, so commonly employed, and there are two donkey boilers in place of the usual single one. Then again, the forced draught system is operated by two independent fans and engines, so that the chances of a possible complete breakdown have been reduced to a minimum.

When designing the engines of the "Falls of Inversnaid," the makers, Messrs. Rankin and Blackmore, of Greenock, earnestly laid themselves out to make them their ideal of the most perfect type for a cargo steamer, combining the greatest possible simplicity with compactness and smooth working. That the design is simple goes without saying, as the most superficial glance at the engravings will show, for there are only two engines in place of the three which form the ordinary triple-expansion engine, and, as will be seen, a very special feature is presented by the extreme ease and rapidity with which all the various parts can be examined or overhauled. Then these engines are so compact that they take up 3 feet less room fore and aft than the makers' triple-expansion engines of equal power.

With regard to the working of these engines, this was the subject of hearty congratulation from the engineers present at the trial, as the uniform smoothness and absence of vibration quite surprised those who were prepared to judge this matter from the usual standpoint of the old-fashioned two-crank compound type, forgetful of the fact that, with quadruple-expansion, the steam can be economically used during a much longer portion of the piston stroke, and further, that the high-pressure steam in the two upper cylinders affords admirable cushioning to the under cylinders, with their comparatively low pressures. The upper cylinders are connected to the lower by strong cast-iron brackets, arranged so as to permit the lower cylinder covers to be lifted for examination of pistons (and removal, if need be,) without disturbing the upper cylinders. To save friction and trouble, and also to enable the under cylinder covers to be raised high enough to give ample room for overhauling, there is only one piston-rod stuffing-box (bolted and in halves) between each pair of cylinders. These stuffing-boxes are fitted with a combination of elastic and rigid metallic packing, and the glands can be easily adjusted while the engines are running, so that the advantages of tail rods are secured without the trouble of leaky glands, which have given rise to so much complaint with the high-pressure cylinders of triple-expansion engines. The reversing gear is arranged with a small steam engine, actuating a worm-wheel on the "all-round" principle, and has double-barred link motion of ample strength, made adjustable at the wearing parts. The eccentric rods are of best forged scrap-iron, with double jaws, fitted with brass bushes and malleable iron covers; the straps are of polished wrought-iron, lined with brass. The weigh-shaft has been fitted with malleable iron levers, having oblique slots, so that the cut-off may be independently regulated for each half of the engine. The air pump is single-acting, and the circulating pump double-acting, and they, along with the feed and bilge pumps, are worked by strong malleable iron levers, coupled at one end to the connecting-rod gudgeon of the after engine, and at the other end to the pump crosshead by double links, fitted with adjustable solid brasses secured by double nuts. The crank-shaft is of the built description, of best forged iron, made in two interchangeable pieces. The turning gear consists of a large wheel fixed on the after end of the crankshaft, actuated by a worm held by a strong cast-iron bracket bolted on the sole-plate, and it can be worked either by hand or by means of rope gearing, driven by the ballast donkey engine.

The Toledo, Columbus & Southern Railroad is experimenting with crude oil for fuel, so far, it is said, with good success.

A Detroit firm recently made two sheets of copper ¼ inch thick and 11½ feet square. Each sheet weighed 3,000 lbs.

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The Minnesota News Company, St. Paul, Minn.
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The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence R.I
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y

NEW YORK, DECEMBER 20, 1888.

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Change of Date.

As the AMERICAN MACHINIST has heretofore been issued, there has been a discrepancy between its date and time of appearance. Beginning with Jan. 3, we shall make the date conform to the day of issue, and, in order to do this satisfactorily, the date, beginning with the present issue, will be gradually changed up to that time. Further than this gradual shifting of dates for a few issues, there will be no change, the paper appearing on Thursday as usual.

Who Pays Postage?

There is a movement on foot to secure still cheaper letter postage, it being proposed to reduce it to one cent per ounce, just half the present rate. This, it is thought, would reduce the receipts of the Post Office Department by ten to fifteen millions of dollars, though, in the light of experience with past reductions, we are disposed to doubt it.

But an interesting thing in connection with the matter is the discussion which is going on in the press regarding it. The *Chicago Times*, for instance, thinks that it is not advisable to make the reduction, because it will not appreciably benefit anybody except business men, who, as a class, are abundantly able to pay a fair price for the maintenance of the service.

Such an argument shows how easy it is, even for those who are supposed to be leaders of thought, to entirely misapprehend the principles involved in the discussion of an economic question. Such arguments are quite common, and are generally accepted as conclusive by those who never stop to look below the mere surface of things. To show their fallacy, it is only necessary to recall the indisputable fact that, generally speaking, the consumer of a thing pays all the *necessary* cost of its production, and that all the necessary expense involved in the carrying on of business or commercial operations must be paid by the consumer of the goods dealt in. Anything which increases the expense increases the cost of the goods to the consumer, and, on the other hand, anything which lessens the expense decreases the cost of the goods to the consumer.

What has been called the effective production of goods includes not only their manufacture, or all that which is necessary to transform them from the raw materials to the finished products, but all that is necessary to place them in the hands of the consumer, ready for use, in such quantities and at such times as he may need them.

The carrying on of legitimate and honest business operations is a necessary—an indispensable part of this effective production, the expense of which must inevitably be borne by the consumer. From this it follows that the consumer of goods pays the postage which is necessary in carrying on business, because that postage, like every other necessary expense, is an element of cost in the production of goods.

Of course, we do not mean by this that every merchant and manufacturer, finding his postage bills reduced one-half, will immediately mark down the prices of his goods, and give his customers the full benefit of the reduction; but we do mean that it will enable him to reduce prices when competition demands it, and it will help to enable competition to force reductions in prices, and thus eventually inure to the benefit of the consumer.

Of course, this line of argument applies only to business in which competition is open and free; not to that which is closely monopolized; but even there a reduction of the necessary expenses of carrying on business makes it more difficult for monopolies to maintain their position, and tend to help in breaking them down. And the only final, effective remedy for monopolies is to deprive them of that which is the basis of their monopoly, not to increase the cost of carrying on their business. But one thing should never be lost sight of, and that is that the consumer pays all the necessary expense involved in the production of that which he consumes.

He who thinks that the only payment of postage which comes out of his pocket is that which he pays directly into a post-office for postage stamps to stick upon his own letters, is deceived.

Piece or Day-Work.

On another page will be found a communication from a working mechanic, in which he expresses his views upon the piece-work question; and, as those views are founded upon years of shop experience, they are entitled to consideration.

The editorial article referred to by our correspondent appeared in our Nov. 24 issue, and some of the points brought forward by him were touched upon in a subsequent article, which had been written before the receipt of his communication.

We have known the grossest injustice to be inflicted upon workmen under both the piece-work and the day-pay systems, and, on the other hand, we have known of establishments in which the workmen were treated with the utmost fairness under both systems. Much more depends upon the character and intelligence of the employer and his men, than upon any system; and an employer who is disposed to treat his workmen fairly and well, will usually do so, no matter what system he employs. If he is not so disposed, he will find ways of imposing upon them under either system, provided, always, that the workmen are so situated as not to be able to help themselves. If two or more workmen are after every job, employers can inflict ill-treatment upon their men if they choose to, and cannot see the advantage to themselves of doing otherwise. For our part, as a result of some years of experience, and considerable observation of these matters, we think it pays in dollars and cents to treat workmen fairly and well, and we believe the piece-work system has advantages over the other as a means of doing so, and at the same time rendering exact justice—paying men in exact proportion to their ability.

As we have said before, we think workmen should be paid in some way for improvements, and that it pays employers to have it well understood that improvements made by the men will be fairly paid for.

As to what the result will be, where the foreman of a shop is paid a percentage on the work completed, we can only say that it will depend upon what manner of man the foreman is. But if, at the same time, he is the only inspector of the work—if there is no one else whose business it is to look after every detail of it, and see that it is properly done, we should not expect a very high quality of work to be done in that shop, unless the foreman is an exceptional man.

Mechanical Drawing.

Several of our correspondents ask us to recommend books from which mechanical drawing can be learned. Mechanical drawing is based upon geometrical principles, and we therefore advise all our correspondents who wish to understand it thoroughly, to obtain a good elementary geometry, and a good descriptive geometry, and study these in connection with articles on practical drawing, now appearing in the AMERICAN MACHINIST. Following such a course, we believe the earnest, persevering student will be able to master the subject during his leisure hours at home, without any teacher. With a teacher the progress will be faster, and the labor will be lighter; yet there is nothing to prevent anyone, who has the ability and taste for drawing, to learn it without a teacher, as it is really not a difficult subject to master.

The great drawback in the study of mechanical drawing is, that students do not commence right, that is to say, they either hurry over the elementary principles or neglect them altogether, and attempt at once to make drawings of machinery, etc., which practically amounts to commencing the study of the subject at the wrong end; and such a course not only makes the study a difficult one, which otherwise would be easy, instructive, pleasant and profitable, to those who even do not intend to become draftsmen, but in a large number of cases it leads to failure. Hence, commence at the beginning, become thoroughly familiar with the underlying principles, and do not pass from one problem to another before the previous one is understood.

Another question often asked is, how long do you think it should take a person of average ability, studying three or four hours a day, to fit himself for a position? Now, a little reflection must make it apparent that it is impossible for us to answer this question satisfactorily, unless we are acquainted with the correspondent. Yet it may be said that, in about a year, a person may know enough to qualify him to enter an office, and then he may find that the study has only been commenced.

We also often receive questions in regard to the location of schools, which are sometimes extremely difficult, if not impossible to answer. For instance, we have the following question before us: Are there any schools in Chicago where drafting is taught? and what do you think is a reasonable price for private lessons? Now, there is no doubt but that there are many schools in Chicago, the same as in all large cities, in which drawing is taught, yet we cannot name any, as we do not keep a record of them. Neither can we say what should be a reasonable price for private lessons. Teachers will, and have a right to charge according to their standing and success, and it is simply a matter of judgment on the part of the scholar whether he will be benefited more by paying a high price than by a lower tuition fee.

We are also asked: Are the ranks of mechanical draftsmen crowded? and what pay do they receive on an average? Mechanical draftsmen may be divided into two classes; one class embraces those who can simply make a drawing, but cannot design, to the other class belong those who can design, and are also thoroughly familiar with drawing in all its branches. The ranks of the former class are crowded, and their average pay will be somewhat less than that of ordinary mechanics. For the latter class there is generally a demand, and these draftsmen often set their own price.

In our last week's issue we asked for copies of No. 2, Volume 2 of the AMERICAN MACHINIST, promising to pay one dollar each for such copies, in good condition. The number of the volume was put in Roman characters, and the mistake has been made by several, of those who saw the notice, of reading this as volume eleven. The number we want is No 2, Volume 2.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(547) J. H., Philadelphia, Pa., asks: Will you be kind enough to give me a rule by which you can cut a certain number of threads to the inch, on a lathe, when there is no table to go by? *A.*—We have already published such a rule in this volume. You will find it in the answer to Question No. 15, in the January 14th issue.

(548) G. W. P., New York, asks: In which number of the AMERICAN MACHINIST can I find a description of a working model of the locomotive valve gear? I think it was published about four years ago. *A.*—You will find it illustrated and described in our issue of May 26, 1883. The articles to which you refer will be published in book form.

(549) G. K., Sag Harbor, L. I., asks: What would be the advantage of increased pitch in rifling gun barrels? *A.*—We believe it is now conceded that there is no advantage. The advantage, if any, would be in bringing the ball gradually up to its full motion of revolution; but, as the ball starts slowly, and its speed increases in the barrel, the increased pitch does not appear to be needed.

(550) E. S., Fall River, Mass., writes: I have an idea of making a compound engine expanding in both cylinders without any back pressure, at least not more than that occurring in any single-acting engine. What per cent. in saving will it be in fuel over the ordinary compound engine? *A.*—We cannot tell without knowing more of your engine. It seems to us that you will have a more difficult problem on hand than you expect it to be.

(551) "Ebony," Pittsburgh, Pa., asks: Can you inform me of a bronze for brass, that can be used without heat, and make a dead black (corrosive sublimate is not black enough)? *A.*—Try polishing the article with tripoli, then washing with a mixture of 1 part nitrate of tin and 2 parts chloride of gold. After allowing this wash to remain on about 12 or 15 minutes, wipe off with a linen cloth. An excess of acid increases the intensity of the tint.

(552) H. M. P., Dayton, Ohio, writes: Can you tell me how I can get a distinct blue print from a blue print? I have soaked the print in boiled linseed oil, and also varnish but with only partial success. There are many prints sent to the office that I would like to duplicate and triplicate without the cost of retracing. *A.*—Good distinct blue prints can only be obtained from good tracings. You must not expect anything else than a partial success in the attempt to make a blue print from a blue print.

(553) C. M., Yonkers, N. Y., writes: Will you please inform me where I can obtain a book treating on the subject of making blue prints, or did you publish any articles in your paper treating on this subject which will give me the information I seek? *A.*—We do not know of a book which treats on this subject. We believe you will obtain all the information you seek by reading the articles on blue printing, published in our issues of July 31, 1886; January 1, 15, 22, 29, June 25, July 9, 1887, and answer to Question 449 in our issue of Nov. 5, 1887.

(554) H. F., Shamokin, Pa., writes: Can you give me the best method of dressing and tempering machinists' cold chisels, and whether or not edging down the sides or jumping up the point injures the grain? Some cut the sides off instead of hammering down. *A.*—We think good steel may be hammered or cut in almost any manner without injury, so long as the man who does it is a good blacksmith, and skilled in the art of forging steel. 2. Which is the best way to see the temper, by rubbing it or watching the scale color? *A.*—We prefer rubbing.

(555) D. G., Galva, Ill., writes: Please inform me which is considered the best for health—water pumped through a plain iron pipe, galvanized pipe, or lead pipe, for house use and drinking? *A.*—That depends on the quality of the water. Generally we prefer the galvanized pipe. 2. Is any one as good as the old oaken bucket that hangs in the well? *A.*—We believe the galvanized pipe to be better than the bucket or wells. The latter when situated in the city, we avoid; when situated in the country, we look upon them with suspicion, unless we are convinced that they are far away from sewers or cesspools.

(556) W. B., New York, writes: Is there a piece of machinery, something the shape of a salmon wheel, with a copper wire instead of a line attached, the same to revolve slowly and still hold up about one hundred pounds from a height to equal the length of the wire around the drum of the wheel? The wheel may be from six to twelve inches wide and about five inches diameter. *A.*—Not knowing the purpose for which your device is to be used, we cannot say whether you can find anything in the market to suit you. But we believe you will have no difficulty in getting the required pieces made after your device has been perfected and a drawing made.

(557) J. R. M., New York, writes: Would you kindly explain to me how the index of an elevator is worked, supposing the floors to be different heights, and the index on every floor is exactly the same size with equal divisions? Take, for instance, Equitable Building. *A.*—From your question we infer your impression is that matters will be complicated by using the same size index for different heights of floors. Such an impression is erroneous, as the opposite is the case. The pointers on each floor have exactly the same amount of motion, and consequently the indexes must be exactly alike. The height of floor will in nowise interfere with the divisions on the index.

(558) C. W. S. asks: Can you or any of your readers tell me: 1. How to produce the brown or steel-grey finish upon brass, such as is seen upon surveyors' instruments? *A.*—Into 6 gals. muriatic acid put 2 lbs. yellow arsenic, and 1 lb. black oxide of iron. Have the pieces thoroughly clean and dry, and dip them until the desired shade is produced, then rinse them in clear water and dry in fine sawdust. They are then lacquered. 2. Is there any metal, mineral, or composition, that can be had in strips 1-12″ × ¼″, about equal to cast-iron in strength to resist pressure, and that cannot be soldered by ordinary processes? *A.*—We do not know of anything that will answer the purpose.

(559) L. T. E., Haverford College, Pa., writes: I am designing an automatic steam engine, cylinder 9″ × 9″; cylindrical valve admitting steam in middle and discharging at ends; latest point of cut-off at 5½ inches; engine is to run 400 revolutions per minute. I wish to know the best relative position of the points of compression and exhaust for latest point of cut-off. *A.*—It is difficult to advise you, without knowing more of your valve motion. On general principles, we believe that in automatic engines the best results will be obtained by regulating the compression so as to obtain smooth running at the average early point of cut-off, and at this point not to allow the compression to exceed the boiler pressure.

(560) G. J., Rockwood, Tenn., writes: There is a dispute between two men in this place. They have left it to me to decide between them. One claims that the Westinghouse air brake is an American invention, and that it was adopted in general use in America before any other country took hold of it. The other claims that the air brake was adopted in England years before the Americans took hold of it, and, after it proved successful in England, the Americans went to work and used the same after the English had spent their money to perfect it. *A.*—We submitted these questions to the Westinghouse Air Brake Co., who replied as follows: The air brake is an American invention, and was used in this country before taken to England.

(561) L. B. B., Camden, N. J., asks: Is there a fixed rate per horse-power governing those who rent steam power without renting rooms? I own a building; tenant A on the first floor supplies my tenant B on third floor with three horse-power for light manufacturing purposes, from 7 A. M. until 6 P. M. The same boiler heats steam pipes in the room, which is 40′×90′. A difference of opinion existing as to the value of service, you are asked if there is not an established rate for power. *A.*—There is no standard charge or fixed rate per horse-power. In our opinion there is only one way to avoid dispute, and that is to put in a meter, and charge according to the number of kals used, the price per thousand kals having previously been agreed upon. See answer to Question 473, in our issue of Oct. 27, 1888. 2. Can your paper be bought in Camden or Philadelphia? *A.*—The AMERICAN MACHINIST can be obtained from newsdealers everywhere.

(562) B. P., Pittsburgh, Pa., asks: If I have a cylinder, 8 inch bore and 12 inches long, fitted with a piston, and let in steam at a pressure of one pound per square inch, and force the piston to the other end, and then shut off steam—1. How long would it take to condense if the temperature around it was about 60°? *A.*—It would depend a great deal upon conditions which you do not state, such as thickness of the walls of the cylinder, the material of which it is composed, and the time consumed in forcing the piston up by the steam. 2. If I have a weight of 100 pounds fastened to a chain, and the chain is wound around a shaft 1 inch diameter, upon which is a wheel 12 inches diameter with a chain attached, what weight will be required on the latter chain to balance the weight of 100 pounds upon the former? *A.*—Leaving out of the consideration the effect of the size of the chain, a weight of 8.333+ lbs. would be required. But for a close calculation it would be necessary to ascertain the extreme distance from the center of the shaft to the center of the chains, which would modify the proportions somewhat.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

The Best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Drop presses, punches and shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Mechanical drawing taught by correspondence. Thoroughly practical. I. Donald Boyer, Dayton, O.

"How to Keep Boilers Clean." A 96 page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Davis Key-Seating Machines, kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Common sense oil filters are a wonder. They repay cost quickly. C. F. Baker, Minneapolis, Minn.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

The economy of Electric Lighting for Factories is found in catalogue of the Waterhouse Electric & Manufacturing Co., Hartford, Conn.

Upright drills, improved, sizes 21″, 23″, 25″, 28″, 32″, 36″ swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Patents obtained. Patent litigation conducted, R. G. DuBois, Patent Attorney, 928-930 "F" street, Washington, D. C. Correspondence invited.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila., Pa.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Dec. 1, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

With my System, Exhaust Steam Heating costs nothing for fuel; Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N.Y.

A system of easy lettering by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Dec. 15, 1888 issue, 65 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 80 articles have thus far appeared up to and including the Dec. 20, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York

MANUFACTURES

Story & Thompson have started a machine shop at Culloden, Ga.

The E. W. Moon Machine Works, St. Louis, Mo., are being enlarged.

Warren Shaw is building a large shoe factory at South Peabody, Mass.

The Illinois Central Railway Co. will build repair shops at Durant, Miss.

Ward and Stapp will build a flour mill and an elevator at Sheffield, Ala.

The Galena Foundry Company has been incorporated, to do business at Galena, Kan.

The St. Louis (Mo.) Stamping Co. have begun the much needed addition to their works.

The United States Rolling Stock Company will build car spring works at Anniston, Ala.

The Solid Steel Co., Canton, Ohio, have recently put up works for making Mitis castings.

The Works of the Jenny Electric Company, at Fort Wayne, Ind., lately burned, will be rebuilt at once.

There is water-works agitation at Nicholasville, Ky.; Georgetown, Ky.; Harrodsburg, Ky.; Russellville, Ky.

The capital stock of the Atlanta (Ga.) Glass Co. is to be increased to $100,000 and the capacity of the works doubled.

The Denver (Colo.) Carriage Company have erected a building two stories high, which they intend to make four stories.

A company known as the Trimlin-Heidenger Car Heater and Illuminator Company, of East St. Louis, Mo., has been incorporated.

The Wilbraham (Mass.) Woolen Company has been incorporated, with a capital of $33,000. Frank H. Baker is president, and Leonard B. Baker treasurer.

Important additions are to be made to the Bath (Maine) iron works. There is at present being built at the works a triple expansion engine, cylinders 22, 34 and 55 inches diameter by 36 inches stroke, for a steamboat.

J. M. Carpenter, Pawtucket, R. I., has issued a new catalogue and price list of taps, dies, screw plates, tap wrenches, die stocks, etc. In addition to a very complete illustration of the tools manufactured by Mr. Carpenter, the catalogue contains some very convenient tables of the sizes of drills required for taps, some of these tables being original.

The Keystone Iron Works Company, which is building new works at Kansas City, Mo., will build general machinery, and make a specialty of hoisting engines. Their buildings have a frontage of 500 feet, and are 120 feet deep.

The Hussey Re-Heater and Steam Plant Improvement Company, 15 Cortlandt street, New York, has issued several circulars illustrating a variety of purposes for which exhaust steam, as re-heated by their process, can be used; also their process for superheating live steam, heating air, water, etc., by means of the waste gases of combustion. They publish many testimonials of its saving in public buildings, mills, factories and other places.

E. C. Atkins & Co., Indianapolis, Ind., have issued a revised catalogue of saws and saw tools. The catalogue contains 128 pages, including illustrations and descriptions of circular, band, gang, rip, crosscut and other saws, anvils, straight-edges, hammers and saw tools, for saw makers' use, and mill supplies and saw mill specialties. A valuable feature of the book is the full instructions, with illustrations, for hammering and the care of saws, which will be of great service to sawyers, filers and others using saws.

A Pittsburgh dispatch says: Thomas G. Boyle & Co., the iron brokers, recently purchased 20,000 kegs of nails. The purchase was made at Wheeling, Bellaire and other towns in that vicinity. The large part of the order is from parties in the South, but a part of it will also go West. A little more than a week ago the same firm bought 35,000 kegs of nails. This, with the previous purchase, comprises the big part of the nails in stock at the present time and virtually gives the firm complete control of the nail market.

Mr. Davis, of Cincinnati, O., called upon us a few days ago, on his way home from Worcester, where he had contracted with the L. W. Pond Machine Co., for a planer larger than any yet in Cincinnati. It will be 72″x72″, with a 30 foot bed. Amongst the orders recently filled by his firm (Lodge, Davis & Co.), is an outfit for the Milwaukee Machine Tool Co., which is going to build milling machines for them. Mr. Frank Kempsmith is one of the leaders in the new enterprise, he having withdrawn from the Springfield Machine Tool Co.

G. W. Gail & Ax, of Baltimore, have begun the work of constructing another large tobacco manufactory in that city, wholly distinct from their present one, and have ordered a 300 H. P. Webster "Vacuum" heater and purifier for it. Another of these heaters of the same size has been ordered for the gas works in the 25th Ward, now in course of erection by the Globe Gas Light and Construction Co., of 2nd and Market streets, Philadelphia. The latter company now have 2,000 men at work. The plant, when completed, is to furnish an auxiliary supply of gas to the city.

John O'Brien & Co. [St. Louis, Mo.] have begun the construction of an addition to their extensive boiler shops, to be 44 by 180 feet, with high roof, to permit the introduction of overhead travelers. The new structure will stand at the southeast corner of Main and Biddle streets, and will afford room for an increase of at least 25 per cent. in the company's working capacity. Last year and the year before the O'Brien establishment turned out an average of about eight new boilers a week, when busy, and for the next year the company hope to increase the weekly output to twelve boilers.—*Age of Steel.*

The Harrison Safety Boiler Works, Philadelphia, Pa., are well supplied with orders for boilers, and have been running steadily during the year. Amongst their recent orders a good percentage are from old customers who have used the Harrison boiler for 20 years. The firm have recently completed an office building. This is divided into private rooms, general office, drawing-room, etc., the rooms being ventilated by means of a central shaft, and heated by steam. An offset from the main building contains two fire proof vaults, one of which is entered from the drawing-room and the other from the main office.

A press dispatch from Ottawa, Ont., says: A syndicate of Canadian and American capitalists is undertaking a vast scheme for the development of the natural resources of the interior of Brazil. The syndicate includes Mayor Abbott, of Montreal, who is a director of the Canadian Pacific, and Duncan McIntyre, an ex-director of the same company. Their purpose is to stimulate trade between Brazil, Canada, and the United States. A line of steamers will be established between Montreal and New York and Para, in conjunction with a steamboat and railway system extending to the headwaters of the Amazon. S. R. Poulin, civil engineer, who had charge of the surveying party, has just returned from Brazil. Steam craft will ply between Para and a point 300 miles up the Rio Tocantins, a tributary of the Amazon. Dangerous rapids will be overcome by a railway 65 miles in length. At the Western terminus of the proposed railway, connection will be made with two steamboat lines to run on the Rio Tocantins and several of its affluents into the interior, over 1,500 miles from the Atlantic. Mr. Poulin is preparing plans which will be submitted to the Brazilian Government, and if they prove satisfactory valuable concessions will be given to the undertaking. No contracts for the carrying out of the scheme have been made, the Brazilian authorities agreeing to pay all preliminary expenses if the plans should prove unsatisfactory. Concessions to the syndicate will include mining rights for 99 years on the Rio Tocantins and tributaries, and the privilege of purchasing all the land required at one cent per acre.

Machinists' Supplies and Iron.

NEW YORK, Dec. 8, 1888.

Iron—American Pig—The market has remained in a quiet condition, most of the large consumers having supplied themselves with stocks sufficient for the remainder of the year. Some contracts are booked, contingent upon the announcement of next year's prices. We quote standard Lehigh and North River brands $18 to $19 for No. 1 X Foundry, $17 to $17.50 for No. 2, and $15.50 to $16.25 for Grey Forge.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

Wanted—Traveling salesmen for patented specialties in mach. shop tools. Address N, AM. MACHINIST.

Wanted—By a young man a position to learn pattern making and drafting. Wages no object. Lock Box 357, Suspension Bridge, N. Y.

Wanted—Pattern maker. Steady work. State experience, whether married, and give references. Studebaker Bros. Mfg. Co., South Bend, Ind.

Wanted—Position by young man as draftsman; has much experience on engine, hydraulic and running machinery. Percy Brown, Morristown, N. J.

Foundry Foreman—A first-class man wanted, accustomed to machinery work. Address, stating age and experience, BOX 52, AMERICAN MACHINIST.

First-class draftsman wanted immediately on engine design. State experience, age, references and salary expected. Bucyrus Foundry & Manufacturing Company, Bucyrus, Ohio.

Wanted—A capable draftsman, with experience in designing blowing engines and rolling mill engines; a young man having a collegiate education and some shop experience preferred. Address B., care of AMERICAN MACHINIST.

Wanted at once.—A first class machinist to take charge of and take a cash interest in a machine shop, doing a fine manufacturing and repair business in a prosperous city in northern Wisconsin. Address box 45, AMERICAN MACHINIST.

Wanted—Foreman for Steam Pump Works. Must be competent to handle men, with a thorough system, and to get out work in Single and Duplex form rapidly and correctly. State age, wages and experience. Address Box 51, AMERICAN MACHINIST.

Wanted—Foreman in foundry department of an old-established Architectural Iron Works; no one need apply who has not had the experience and the qualification and capacity to take charge of at least 50 moulders. State salary required. Address Foreman, AMERICAN MACHINIST.

Draftsman, young, good designer, with experience in large and small shops, quick mech'l judgment, good business ability—wants connection with small foundry and mach. shop, preferably in hands of young, enterprising man. Accept small salary and interest. References. 782 AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none; price in reach of all. Crescent Mfg. Co., Clevelan , O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Punches, dies and special machinery built to order C. F. Langston & Co., 70 N. 4th St., Phila., Pa.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Wanted.—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

For Sale, Cheap—A complete wire nail plant, consisting of 25 machines of the most modern construction, tumbling barrels, reels, etc. Address Sweet's Manufacturing Co., Syracuse, N. Y.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

A foundry and machine shop in the natural gas belt in Indiana for sale at a bargain, on easy terms; doing a good business; has a good specialty. Address P. O Box 573, Wabash, Ind.

Tools Wanted—Steam hammer to work 6 in. iron pipe; machine to thread 6 in. pipe; power shear to cut 1¼ round iron. Good second-hand ones will do. Geo. R. Lombard & Co., Machine Work and Mill Supply Store, Augusta, Ga.

Wanted to Purchase—Engine Lathe about 18 ft. swing, 10 ft. between centers, Compound Rest, 4 Jaw Chuck and Face Plate. Steady Rest, Countershaft, etc., etc.; also 6 Foot Planer. Address P. O. Box 244, Perth Amboy, N. J.

In stock and for sale, a large lot of new and second-hand engine lathes, iron planers, upright drills, shaping machines and other machine tools. Send for list and catalogue. Address Fitchburg Machine Works, manufacturers of metal working machinery, Fitchburg, Mass.

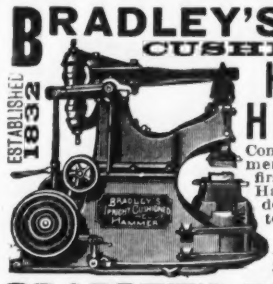
HENRY CAREY BAIRD & CO.,

Industrial Publishers, Booksellers and Importers

810 Walnut St., Philadelphia.

☞Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



ESTABLISHED 1832

Combines the best elements essential in a first-class **Hammer.** Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. **For hard coal or coke.** Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

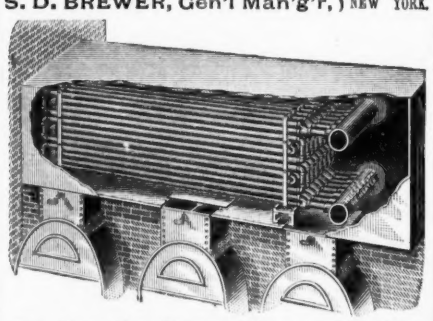
Pat. Aug. 30, 1887.

BRADLEY & CO. SYRACUSE, N. Y.

98 Sudbury St., Boston, Mass.
63 Murray St., New York.

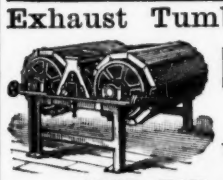
THE HUSSEY RE-HEATER and STEAM PLANT IMPROVEMENT CO.

A. S. HATCH, President, } 15 Cortlandt Street, NEW YORK.
S. D. BREWER, Gen'l Man'g'r, }



Engineering, Steamfitting, and Designing, Remodeling and Improving Steam Plants. Consulting experts in all matters pertaining to the use of Steam and Heat.

Exhaust Tumbling Barrels.



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MANUFACTURERS,

WATERBURY, CT.

SEND FOR CIRCULAR.

OUR SPECIALTY IS

PLANER VISES AND MEASURING MACHINES.

THE GILKERSON MACHINE WORKS,

HOMER, N. Y.

"Star" Foot Lathe Swings 9x25 in.

LATHE

Screw Cutting Automatic Cross Feed, etc.

LATHE

Scroll Saws, Circular Saws, Lathes Mortisers.

Catalogue Free of all our Machinery.

Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y

DODGE

Independence Wood Split Pulleys.

COOKE & CO., No. 22 Cortlandt St., NEW YORK.,

Carry a stock equivalent to over 40,000 iron pulleys, lighter and better than iron.

Read the following extract from a letter from one of our customers, referring to these pulleys.

"P. M. BARROW,

"Tanner, Currier and Dealer in all kinds of Rough "and Finished Leather,

"Ringtown, Pa., July 19th, 1888.

"COOKE & CO.,

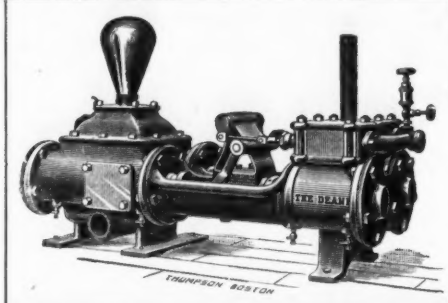
"Gents:—"******** They are the best pulleys I ever "saw; our stone ran so fast that the grain could not get "down, but would fill up the eye in the stone and when full "would drop in a quart or two at a time and slip the strap "on the line shaft, and threw it off several times. But "there was no slip to this. I told my son we would never "buy an iron pulley again.

"Yours truly,

"P. M. BARROW."

Write for Prices, Mentioning this Paper.

IMPROVED PUMPING **MACHINERY** For Every Class of Work | Send for New Illustrated **CATALOGUE.**



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Manufacturers of

STEAM and POWER PUMPS

FOR ALL PURPOSES.

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ENGINE LATHES.

THE HENDEY 18-INCH ENGINE LATHE

Combines modern design with superior workmanship at a moderate price. No extra charge for Compound Rest, Hollow Spindle or Power Cross Feed. Length of beds, 6, 8, 10, 12, 14 and 16 feet. Have other sizes of Lathes; also, Shapers, Planers, &c. Send for Catalogue and Prices.

THE HENDEY MACHINE CO.,

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MACHINERY STEEL CRUCIBLE or BESSEMER. HARD OR SOFT. Strong. Sound. Uniform.

MILLER, METCALF & PARKIN,

64 & 66 SO. CLINTON STREET, CHICAGO, ILLS. | CRESCENT STEEL WORKS, PITTSBURGH, PA. | 480 PEARL STREET, NEW YORK, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting FOOT AND POWER **LATHES**

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

167 West Second Street, CINCINNATI, O.

OUR SPECIALTIES, 8, 12, 14 and 18 inch Lathes.

STEPHENS' PATENT VISES.

QUICK-ADJUSTING CAM AND TOGGLE JOINT.

Stationary or Patent Swivel Bases.

INCOMPARABLE FOR STRENGTH, DURABILITY FIRM HOLD AND QUICK WORK.

Has improved Taper, Pipe and other attachments. Made in 2, 2¾, 3½, 4½, 5½, and 6½ inch width of jaw.

Sold by the Trade. Send for Circular.

TOWER & LYON, MFR'S,

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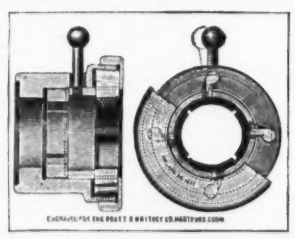

The "MANUFACTURERS' EXCHANGE"

For the quarter is now ready for distribution. It is superbly printed on heavy plated paper, and contains 34 pages, profusely illustrated with the latest inventions in the line of iron and wood-working machinery and their kindred trades, representing manufacturers from all sections of the United States. The book is in itself an example of what a Catalogue should be, and gives many points on the preparing of manufacturers' illustrated printed matter.

The "Exchange" contains a few specimens of our latest novelty in engraving "Transparent Effects," which has attracted considerable attention of late.

Send three two-cent stamps and a copy will be mailed you free.

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Engraver & Printer of Superior Illustrated Work.

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TANITE EMERY WHEELS and GRINDING MACHINES | FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS For Circulars address THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.

Or H. A. ROGERS, 19 John St., N. Y.

FOR SALE, CORLISS ENGINES.

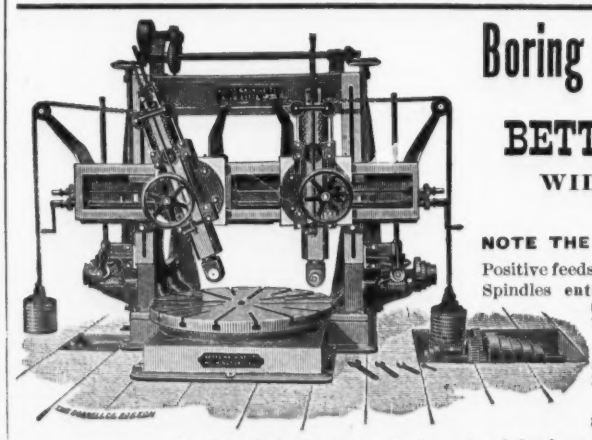
The Fishkill Landing Machine Co., located at **Fishkill, on the Hudson, N. Y.,** offer to manufacturers and others desiring a well built, economical and durable engine, their improved **CORLISS ENGINES.** They are endorsed by many reputable engineers and persons using them. Address as above.

Boring and Turning Mills

MADE BY

BETTS MACHINE CO.

WILMINGTON, DEL.



NOTE THE FOLLOWING ADVANTAGES.

Positive feeds, no **friction.**

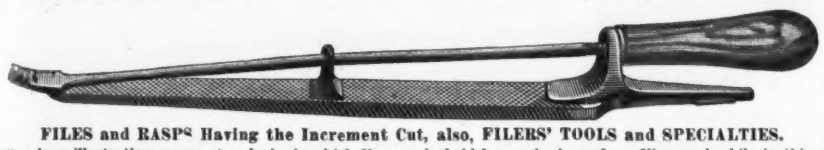
Spindles **entirely independent,** can be moved simultaneously in opposite directions with different grades of feed.

Spindles not **round,** but of such shape as will allow ready adjustment for wear.

Great range of feed and abundance of power.

Send for list of machine tools on hand for immediate delivery.

NICHOLSON FILE COMPANY, *Sole Mfrs. of*



FILES and RASPS Having the Increment Cut, also, FILERS' TOOLS and SPECIALTIES.

The above illustration represents a device in which files may be held for service in surface filing, and while in this condition READILY SPRUNG, in order to give, at the will of the operator, more or less convexity to the working face of the file. It does away with unusual care to obtain a true convexity or "belly" to file sides, and in fact renders great service by enabling the operator to utilize the file to its full capacity.

SURFACE FILE HOLDER No. 4, Adapted to Hold Files 12, 13, 14 in. Long.
" " " " 5, " " " " 14, 15, 16 "

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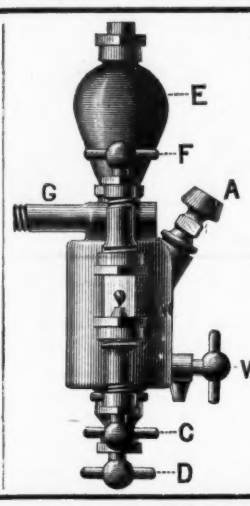

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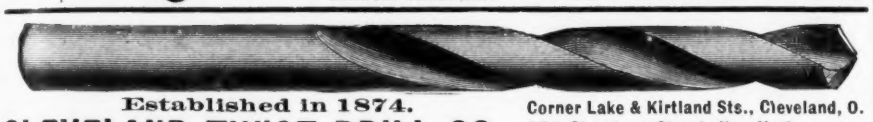
FOR STATIONARY ENGINES AND PUMPS OF ALL KINDS. LUBRICATORS FOR SINGLE OR DOUBLE CONNECTION.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	½ pt.	½ pt.	¾ pt.

NATHAN MANUFACTURING CO.,
92 & 94 LIBERTY STREET, NEW YORK,
Send for Catalogue. SOLE MANUFACTURERS.



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Corner Lake & Kirtland Sts., Cleveland, O.
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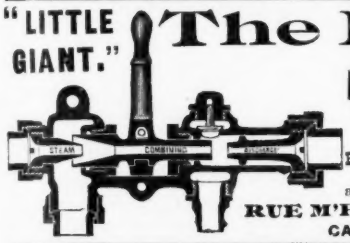
"LITTLE GIANT."

The Best Injector.



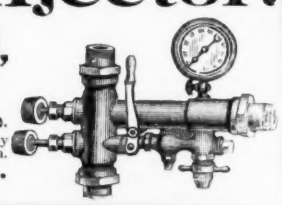
For Feeding all Steam Boilers.

RUE'S ◆ EJECTOR,

Superior to all others for Raising and Forcing Water and other Liquids.

Boiler Washer and Testing Device.

Uses Warm Water, avoiding injury and facilitating the Raising of Steam.



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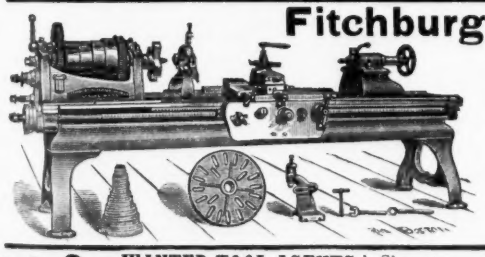
Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, Condensers for Pans, Engines, Steam Pumps, Etc.



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MANUFACTURERS OF

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ROOTS' NEW ACME HAND-BLOWERS.
Slow-speeded, Force-blast. Durable, Compact and Cheap.

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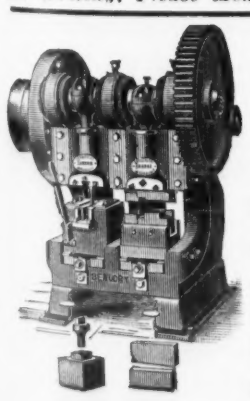

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Power Press

COMBINING PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.
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Sole Manufacturers.
Also manufacturers of
HARD COAL HEATING FORGES.
ROOM 4, MASON B'DG,
70 KILBY ST.,
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38 & 40 Hawley St., Boston, Mass. 36 John St., New York.

No. 0. GRINDING MACHINE, FOR LIGHT WORK, TOOL GRINDING, ETC. TAKES EMERY OR CORUNDUM WHEEL TO 12 IN. IN DIAMETER. ¾" ARBOR.

AND PEDESTAL ON WHICH TO MOUNT ANY OF OUR SMALLER GRINDING MACHINES IN ABSENCE OF BENCH ORDINARILY USED.

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Our COMPLETE CATALOGUE of SCIENTIFIC and INDUSTRIAL WORKS will be sent FREE by Mail on application.

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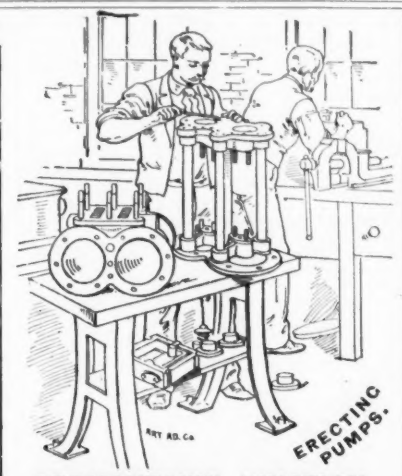

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DUPLEX PUMPS ALL SIZES. EVERY SERVICE

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C. W. LE COUNT,

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REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.85
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.25
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$23.60
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.00

This Dog has a Very Heavy Jaw, so that if the thread wears a Heavier Screw can be substituted.

When ordering, state as above, whether a full set or a set of 12, or small set of 8. These dogs prefer them to any other make.

Le Count's Heavy Steel Dog.
With Steel Screws, Lathe Made and Hardened.

One Small Set of 8—by 1-4 inches to 20 inch, - $ 6.25
One Set of 12—by 1 4 in to 2 in. continued by 1-2 in. to 4 in. 13.25

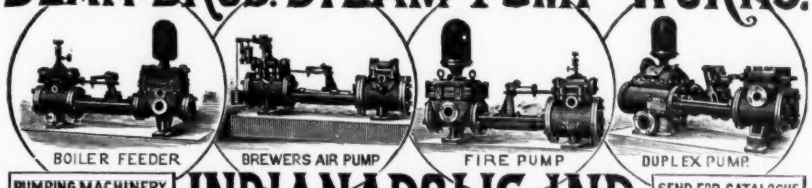
PECK'S PAT. DROP PRESS.

BEECHER & PECK, NEW HAVEN CONN.

DROP FORGINGS OF IRON OR STEEL

BEECHER & PECK, NEW HAVEN CONN.

DEAN BROS.' STEAM PUMP WORKS.



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INDIANAPOLIS, IND.

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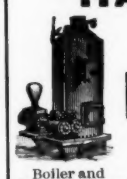

Boiler and Pump Combined.

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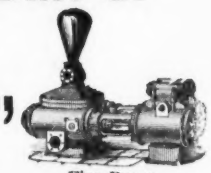
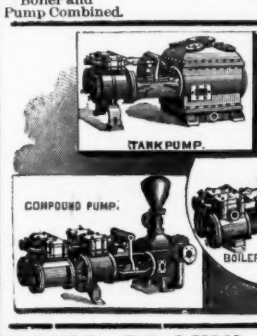


Fire Pump.



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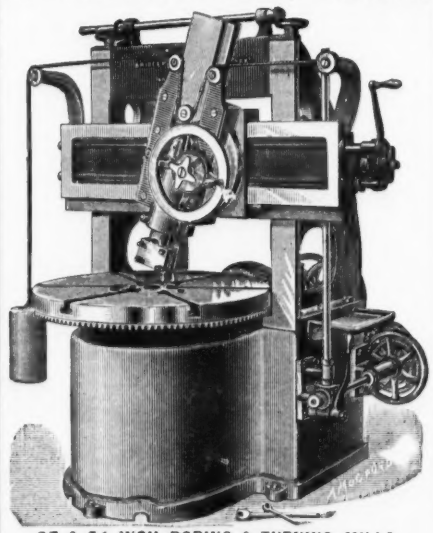

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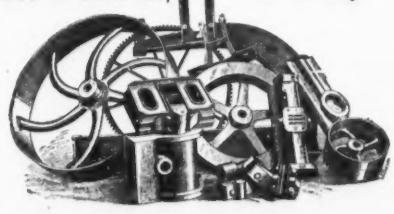

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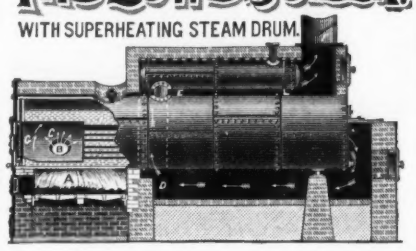

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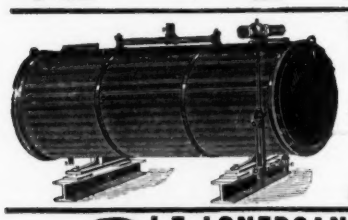

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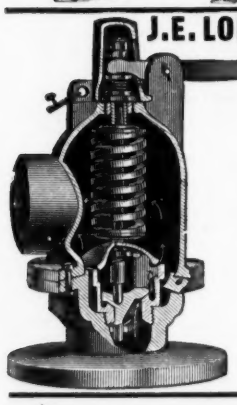

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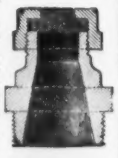

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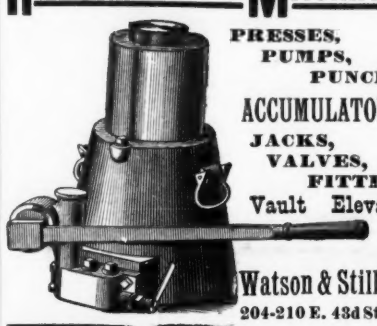

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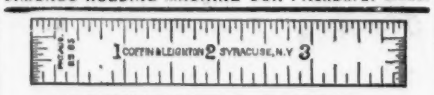

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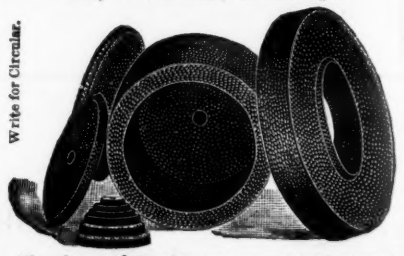

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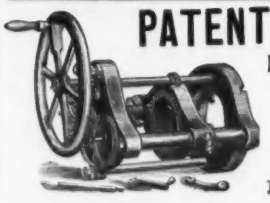

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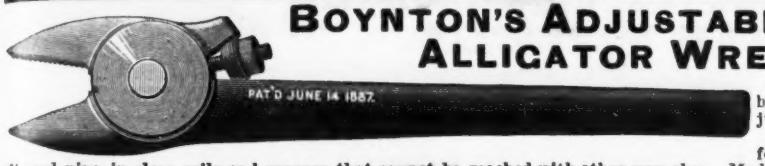

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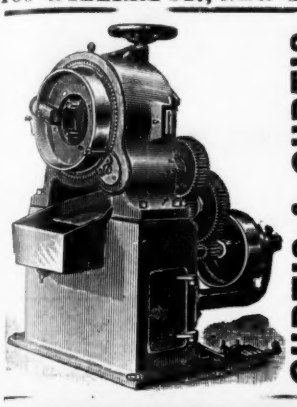

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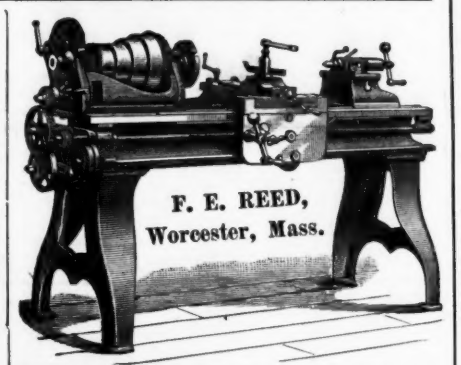

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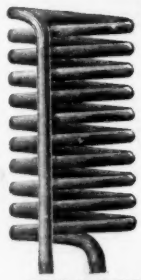

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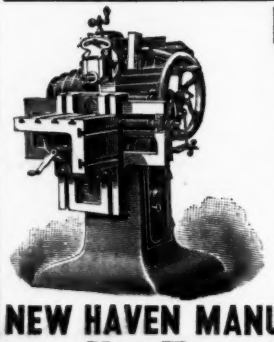

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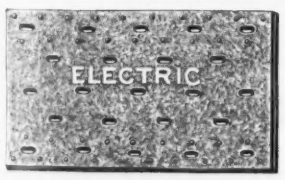

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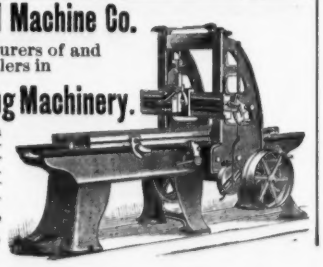

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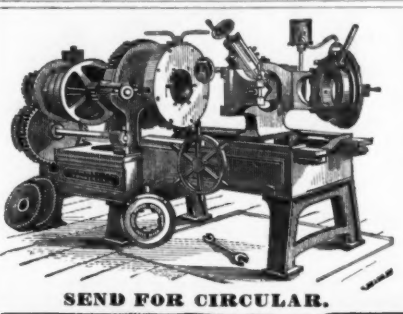

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GENTLEMEN:

We, your Committee appointed to make examination of Class 6, Group 41, have performed that duty and find as follows:

PLANING MACHINE. THE G. A. GRAY CO., Cincinnati, O.

This machine has no competition. We can say of it, however, that it approaches nearer to mechanical perfection than any planer we have ever examined. As it has been awarded a Gold Medal at a former Exposition (Cincinnati,) and as the highest award we could make under the rules would be a Silver Medal, we do not wish to detract from its Golden Record, and therefore make no award.

D. D. MARTIN,
WM. CORRY,
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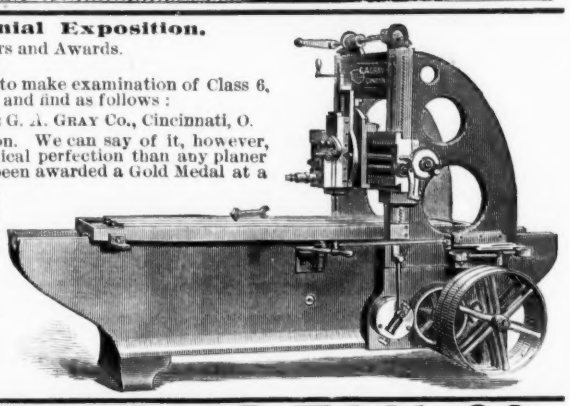
The Board of Commissioners have awarded a Silver Medal.



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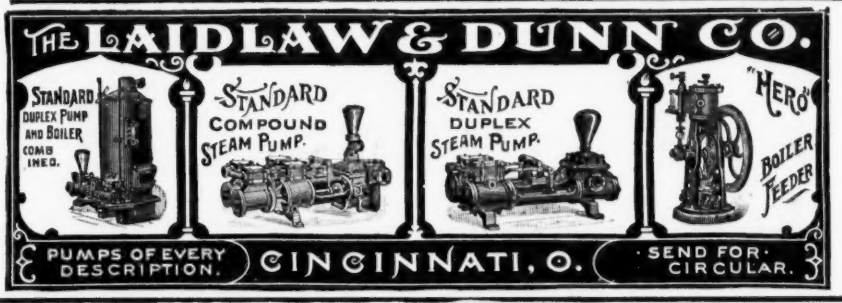

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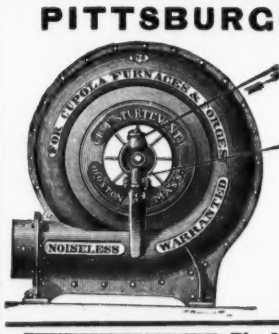

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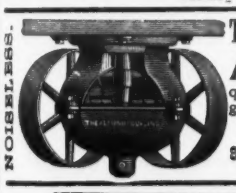

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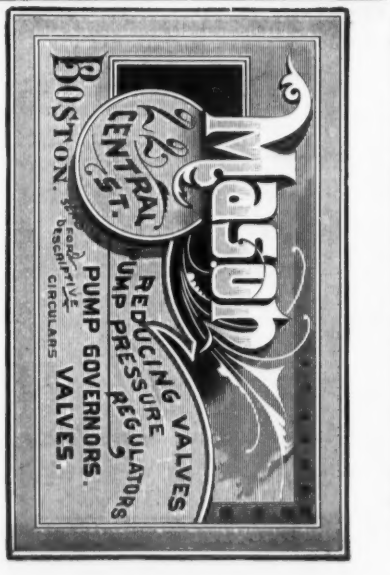

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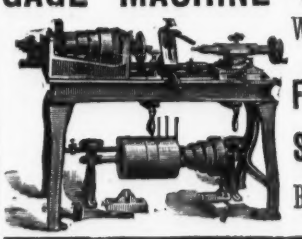

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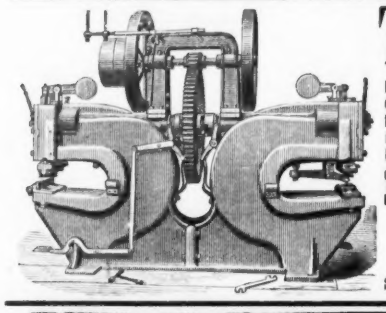

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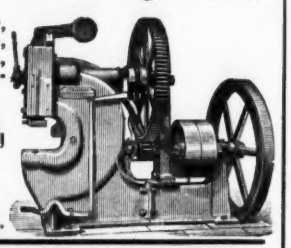

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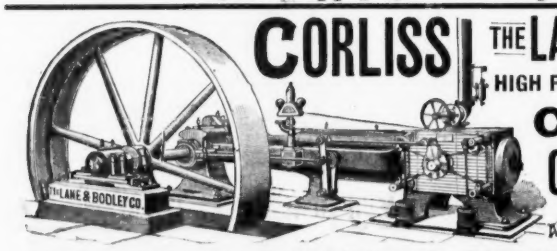

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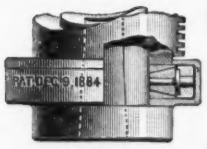

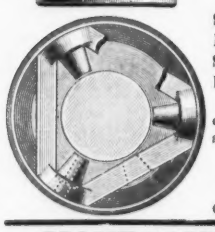

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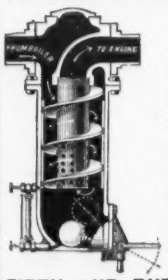

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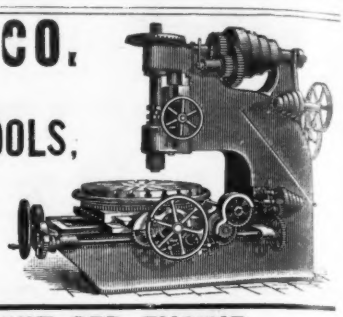

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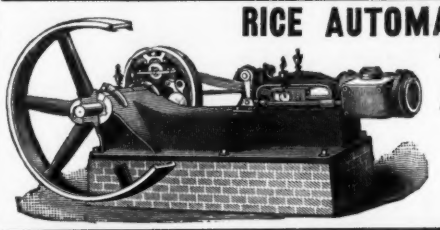

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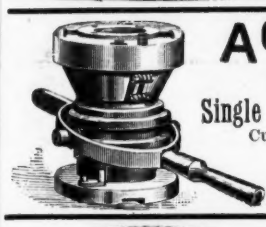

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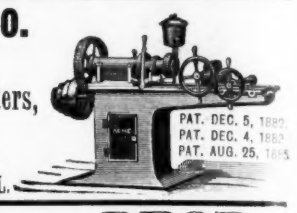

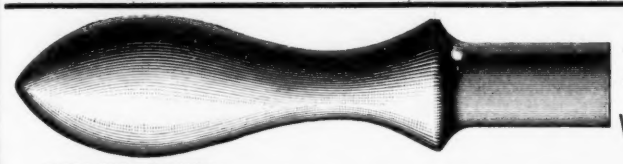

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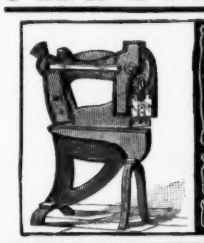

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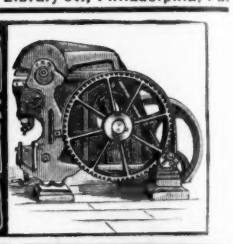

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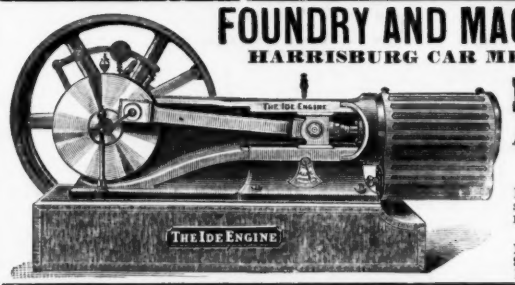

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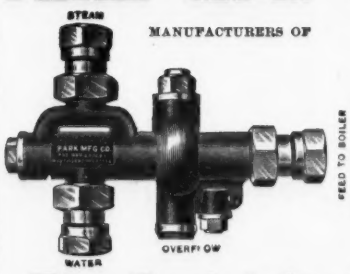

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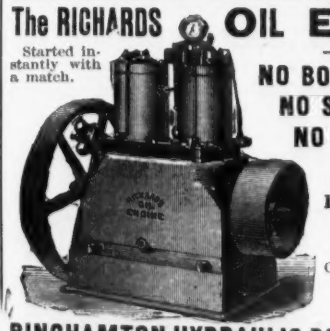

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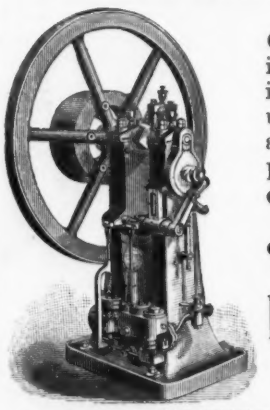

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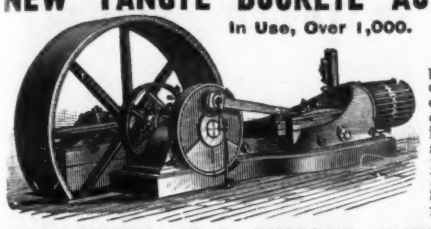

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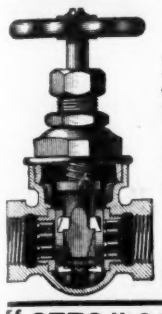

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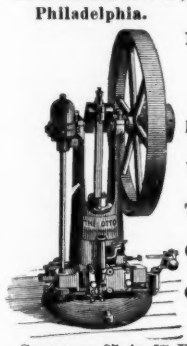

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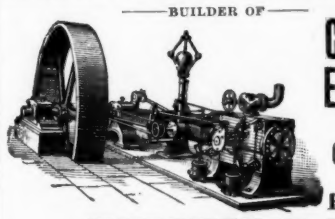

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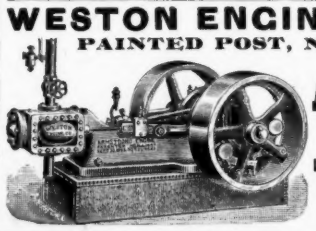

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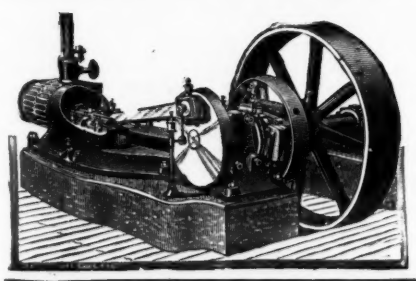

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BUILDERS OF

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BOILERS, ETC.

Complete Power Plants Furnished and Erected.

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16 in. x 42 in.	Planer,	Bridgeport,	new.
22 in. x 4-5 and 6 ft.	"	Powell,	"
24 in. x 6 ft.	"	Powell,	"
30 in. x 8ft.	" each	Atherton, Powell & H. & P.	new.
36 in. x 12ft.	"	Niles,	A 1.
12 in. x 5 1-2 ft.	Engine Lathe,	S. M. & Co.	new.
12 in. x 6 ft.	"	Young,	"
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogart,	"
14 in. x 6 ft	" Gap Bed,	S. M. & Co.,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in x 6 and 8ft.	"	Blaisdell,	"
16-20 in. x 6-8-10 & 12 ft.		Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy, good.
23 in. x 8-10-12 & 14 1-2	"	Bridgeport,	new.
26 in x 12 ft.	"	Wright,	"
24 in. x 14 & 20 ft.	"	Ames,	"
28 in. x 14-16 & 18ft.	Engine Lathes,	T. & S.	"
20 in. Drill		Davis,	"
24-25 25 28 inch Drills		Blaisdell,	"
24 25 28 32 inch	"	C. & S.	"
5 ft. Arm Universal Radial Drill,			"
Cabinet Turret Lathe, Lodge, Davis & Co.			"
No. 5 Screw Machine, Jones, Lamson & Co.			"
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No. 2 Garvin Hand Miller,			A 1.
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Lincoln Pattern,			good order.
No. 1 and 3 Universal Miller,	Brown & Sharpe,		new.
No. 1-2 and 5 Plain "	"	"	"
No. 1 Universal Grinder,	"	"	"
No. 3 Surface Grinder,	"	"	A 1.

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

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62 COLLEGE PLACE & 72 WARREN ST., NEW YORK.

ATTENTION NEW ENGLAND BUYERS.

We have opened at 23 and 25 Purchase St., Boston, a depot for the exhibition and sale of our Improved Engine Lathes, Shapers, Drill Presses and Brass Working Machine Tools, &c. We make a feature of Complete Engine Lathes, without charge for extra attachments.

Call and examine them. Cuts, with full descriptions, free.

LODGE, DAVIS & CO.

23 & 25 Purchase St.,

BOSTON.

WORKS, Cincinnati, Ohio.

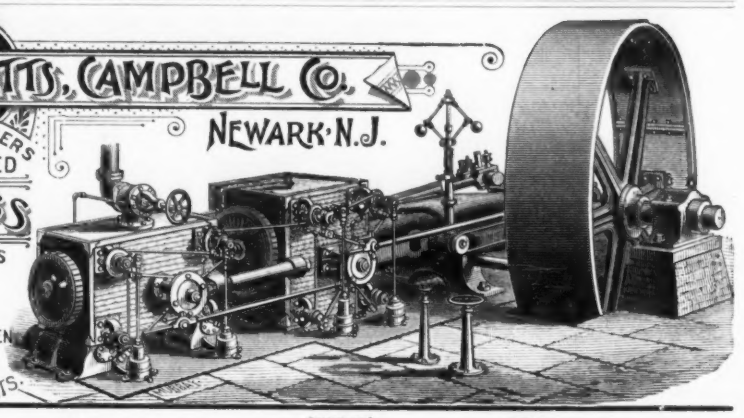
See Advertisement, Page 16.

THE WATTS, CAMPBELL CO.

NEWARK, N. J.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



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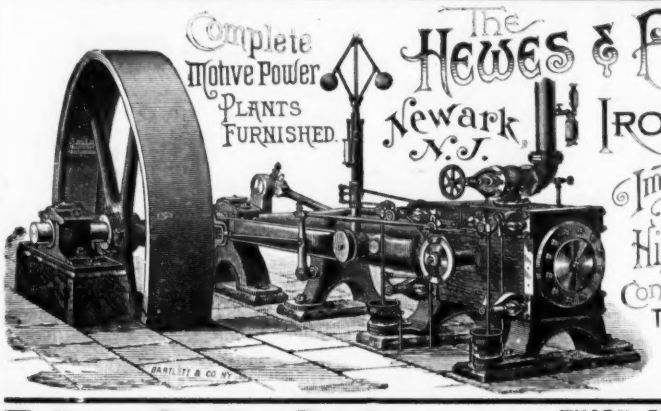
Improved CORLISS Engines. High Pressure, Condensing and Compound. TUBULAR BOILERS.



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FRICK COMPANY, Builders, WAYNESBORO, PA.

NON-CONDENSING, CONDENSING COMPOUND.

40 TO 1,000 H.P.

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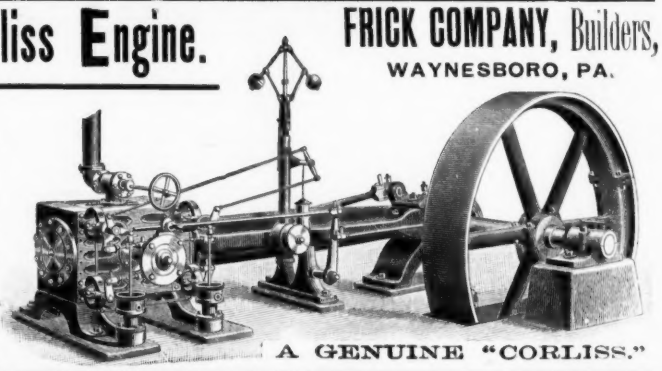

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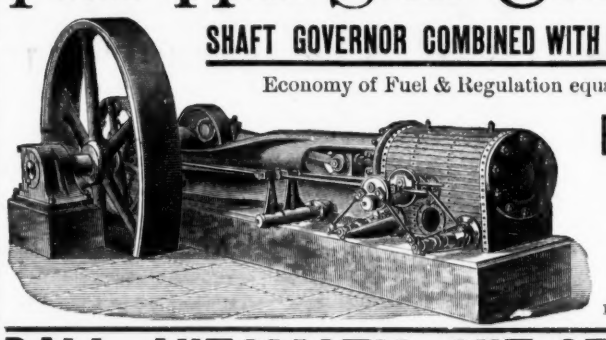
PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

Economy of Fuel & Regulation equal to anything in use.



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BALL AUTOMATIC CUT-OFF ENGINES,

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The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

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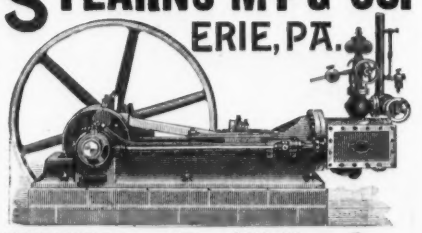

ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

SAW MILLS and GENERAL MACHINERY

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BORING AND TURNING MILLS. LATHES PLANERS DRILL PRESSES F. P. MICHEL ROCHESTER N.Y.

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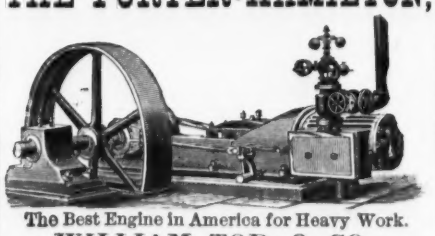

The Best Engine in America for Heavy Work.

WILLIAM TOD & CO.,

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SECOND-HAND Iron Working Machinery.

A very large stock on hand, most of the machines taken in way of trade for new machinery.

Some of these machines are practically as good as new.

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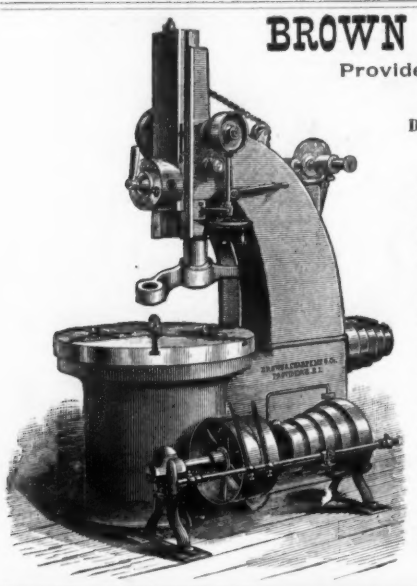
BROWN & SHARPE MFG. CO.,

Providence, R. I., Manufacturers of
MACHINERY AND TOOLS.



Description of No. 2 Vertical Chucking Machine.
Patented August 4th, 1885.

With this Machine from two to four times as much work can be accomplished in a given time as can be done upon an Engine Lathe, and in a much superior manner, the work being more easily trued and fastened in place than upon any machine having a horizontal spindle, and the different tools in the turret-head easily brought into operation in succession, while, from the perpendicular position of the same, the chips fall through the center of spindle of revolving table to the floor, causing no trouble by clogging of reamers, &c.

It has the Capacity to take a pulley 36 in. diam., 16 in. face, and hub of 12 in. in length, and to bore a 4-in. hole in same, making two or three cuts, and finish by reaming, without removing the tools or work.

The Revolving Table is driven by a 5-step cone for 3 in. belt, and geared 6 to 1. Steps of cone so graded as to make cutting speed uniform for 5 different diameters of holes.

The Turret has 4 holes 1 3-4 in. in diameter, and is securely clamped in position. An adjustable dog allows the locking pin to be withdrawn at any part of its upward motion.

The Turret Slide has a movement of 21 in., and an automatic feed which can be easily and quickly changed from the finest ever needed to the coarsest required, it has quick return by hand, and is counterbalanced by a weight inside of column.

Weight, 4,400 lbs.

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MACHINE TOOLS

OF EVERY VARIETY.

NEW YORK, 96 Liberty Street,
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CRANES

THE YALE & TOWNE MFG CO.,
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NEW YORK CHICAGO PHILA. BOSTON

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The best evidence that the JENKINS BROS. VALVES, JENKINS STANDARD PACKING, and JENKINS DISCS have extraordinary merit, and are held in high esteem by the public, is that they are being IMITATED and COUNTERFEITED. The imitations resemble the original in appearance only; they lack the general excellence of the genuine. Our friends and customers will sustain us in our endeavor to manufacture the best goods, by not accepting any goods unless stamped as above. This notice has become necessary by the fraudulent use of our name, and to protect the public from being deceived by unprincipled parties placing imitations on the market.

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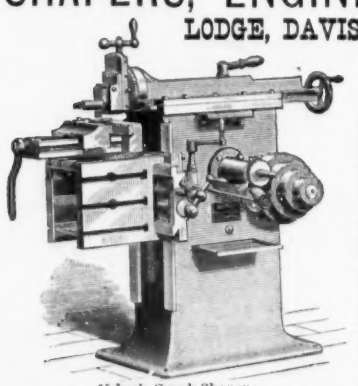
LODGE, DAVIS & CO., CINCINNATI, OHIO.



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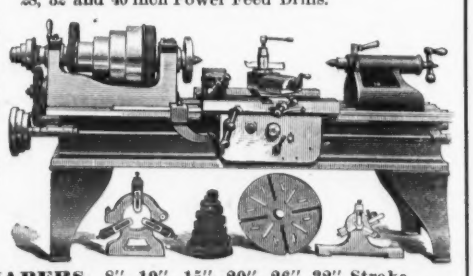
WRITE FOR PRICES, IT WILL PAY YOU.

20 inch Upright Drills. 25 inch Back Geared, and
24 " " "
28, 32 and 40 inch Power Feed Drills.



SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.
ENGINE LATHES, 17", 19", 21", 24", 27", and 38".

(See advertisement, page 15.)

GOULD & EBERHARDT,

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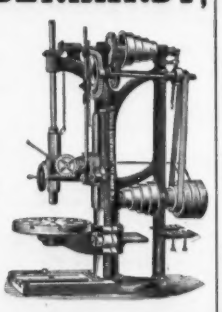

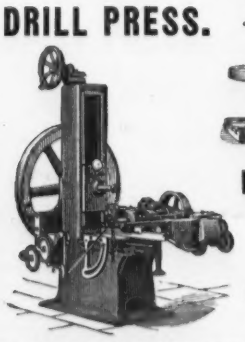

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Drill Presses, Hand Lathes, &c.
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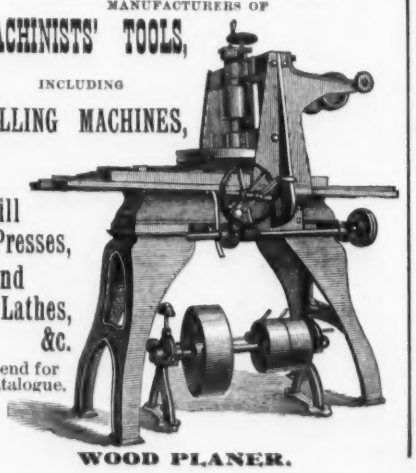

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THE PRATT & WHITNEY CO.,

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Have reduced the Selling Prices
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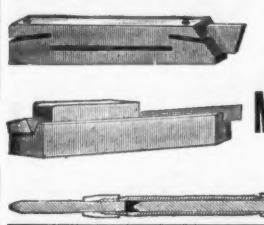
Machine Screw Taps & Combination Lathe Chucks.
Send Specifications and ask for Terms.



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DROP FORGINGS OF EVERY DESCRIPTION.

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BRASS WORKING MACHINERY
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FROM 16 to 48 IN. SWING.

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All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

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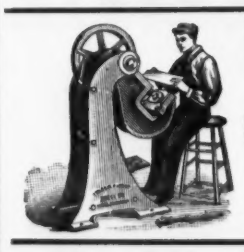
PROPRIETORS
Buffalo Steel Foundry,
BUFFALO, N. Y.



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And other Tools for the Manufacture of all kinds of
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